1282

PHILIPS

Synthesizer 0.01 Hz - 100 kHz

PM 5141

Synthesizer 0.01 Hz - 1 MHz

PM 5142

9499 450 06502 770214

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PHILIPS

Instruction manual
Gerätehandbuch
Notice d'emploi et d'entretien

Synthesizer 0.01 Hz – 100 kHz
NF-Synthesator 0.01 Hz – 100 kHz
Générateur de fréquence synthétisée 0.01 Hz – 100 kHz

PM 5141

9445 051 41..1

Synthesizer 0.01 Hz – 1 MHz
NF-Synthesator 0.01 Hz – 1 MHz
Générateur de fréquence synthétisée 0.01 Hz – 1 MHz

PM 5142

9445 051 42..1

PHILIPS

9499 450 06502

770214

IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die Typennummer und die Gerätenummer anzugeben. Diese befinden sich auf dem Typenschild an der Rückseite des Geräts.

IMPORTANT

RECHANGE DES PIECES DETACHEES (Réparations)

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette caractéristiques.

Note:

The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.

Bemerkung:

Die Konstruktion und Schaltung dieses Gerät werden ständig weiterentwickelt und verbessert. Deswegen kann das Gerät von den in dieser Anleitung stehenden Angaben abweichen.

Remarques:

Cet appareil est l'objet de développements et améliorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.

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Operating manual

1. General information

1.1. INTRODUCTION

Synthesizers PM 5141 and 5142 (with additional frequency range) are based on the principle of direct conversion, which enables a sine-wave to be formed from the time/amplitude function. The frequency accuracy of the wave produced by the generator depends on a reference crystal oscillator.
In this principle there is no phase relationship between the oscillator and the resulting waveforms.

Each synthesizer has two direct socket outputs, a square-wave signal and a sine-wave signal covering the frequencies 0.01 Hz to 100 kHz in 4 ranges for the PM 5141 and an additional range, 100 kHz to 1 MHz, for PM 5142.

Characteristics

- an extended frequency range (0.01 Hz to 1 MHz) and high resolution (10^{-4}) for useful application in the audio frequency, servo-mechanism, electro-medical and vibration testing fields in particular.
- harmonic rejection of −50 dB
- use of the digital principle enabling very low noise levels to be obtained
- floating output giving a high common-mode rejection (thus minimising interference)
- a duty cycle independent of the output frequency
- settling time of one period for each frequency selection between 0.01 Hz and 100 kHz
- an optional remote programming facility.

Both synthesizers are available in a free-standing portable case (4/8 of standard 19-inch width).
The metal cabinet of the two units (89 mm height) has two carrying grips at the front.
The rear has two supports allowing the instrument to be used vertically.
For ease of operation, two tilting brackets are provided to enable the instrument to be angled.

1.2. TECHNICAL DATA

Specifications expressed numerically with stated tolerances are guaranteed by the manufacturer, Values given without tolerances represent the specifications of an average instrument and serve merely as a guide. These data apply at an operating temperature of 23 °C and after a warming-up period of 15 minutes.

Definitions	**PM 5141**	**PM 5142**
Functions	Sinusoidal Rectangular	Sinusoidal Rectangular
Frequency range	0.01 Hz to 100 kHz	0.01 Hz to 1 MHz
Frequency setting	4 thumbwheels	4 thumbwheels
Frequency resolution	10^{-4} from range	10^{-4} from range
Frequency accuracy	5.10^{-5}	5.10^{-5}
Frequency stability	10^{-6}	10^{-6}
Frequency drift	$< 10^{-5}$/°C	$< 10^{-5}$/°C
Power supply	127 V - 220 V ± 10 % or	127 V - 220 V ± 10 % or
	117 V ±10 % 240 V $^{+6\ \%}_{-10\ \%}$	117 V ± 10 % 240 V $^{+6\ \%}_{-10\ \%}$
	50/60 Hz	50/60 Hz
Temperature range	0 °C to +50 °C	0 °C to +50 °C

1.2.1. Rectangular waveshape

Frequency range	0.01 Hz to 100 kHz in 4 ranges	0.01 Hz to 1 MHz in 5 ranges
Rise time (10 to 90 %)	⩽ 50 ns	⩽50 ns

Definitions	PM 5141	PM 5142
Fall time (10 to 90 %)	⩽ 50 ns	⩽ 50 ns
Ringing	⩽ 1 %	⩽ 1 %
Duty cycle	50 %	50 %
Duty cycle tolerance		
f ⩽ 10 kHz	⩽ 100 ns	⩽ 100 ns
10 kHz ⩽ f ⩽ 100 kHz	⩽ 0.5 %	⩽ 0.5 %
100 kHz ⩽ f ⩽ 1 MHz	–	±50 ns
Output	Floating	Floating
Output voltage (on 50 Ω)	+5 V	+5 V
Output voltage (open circuit)	⩾ 10 V	⩾ 10 V
Output impedance	50 Ohm ±5 %	50 Ohm ±5 %
Protection	Against short-circuits	Against short circuits
1.2.2. Sinusoidal waveshape		
Frequency range	0.01 Hz to 100 kHz in 4 ranges	0.01 Hz to 1 MHz in 5 ranges
Spectral purity		
– Ranges 100 Hz; 1 kHz; 10 kHz		
– Harmonics rejection	⩾ 50 dB	⩾ 50 dB
– Non harmonics rejection	⩾ 50 dB	⩾ 50 dB
– Range 10 kHz - 100 kHz		
– Harmonics rejection	⩾ 40 dB	⩾ 40 dB
– Non harmonics rejection	⩾ 40 dB	⩾ 40 dB
– Range 100 kHz to 1 MHz		
– Harmonics rejection	–	⩾ 40 dB
– Non harmonics rejection	–	⩾ 40 dB at 1 kHz from carrier
Distortion 10 Hz - 10 kHz	0.8 %	0.8 %
Distortion 100 kHz - 1 MHz	–	⩽ 1 %
Output voltage (open circuit)	10 V_{p-p}	10 V_{p-p}
Output voltage (on 600 Ohm)	5 V_{p-p}	5 V_{p-p}
Output	Floating	Floating
Output impedance	600 Ohm ± 2 % + 15 μH ± 20 %	600 Ohm ± 2 % + 15 μH ± 20 %
Attenuation	0 to 60 dB	0 to 60 dB
– Pushbuttons	10-10-20 dB	10-10-20 dB
– Continuous	20 dB	20 dB
Attenuation tolerance		
– Pushbutton	0.2 dB	0.2 dB
– Continuous	± 2 dB	± 2 dB
Amplitude variation Max. variation as a function of frequency (output 600 Ω/max. ampl.)		
0.01 Hz ⩽ f < 10 kHz	0.5 %	0.5 %
10 kHz ⩽ f < 100 kHz	1.0 %	1.0 %
100 kHz ⩽ f < 1 MHz	–	2.0 %
Protection	Against short circuits	Against short circuits
1.2.3. Warning light for out-of-range	Yes	Yes

1.2.4. Dimensions	PM 5141	PM 5142
½ rack mount	Yes	Yes
Height	100 mm	100 mm
Width	216 mm	216 mm
Depth	355 mm	355 mm
Weight	3.2 kg	3.2 kg

1.2.5. Optional

Remote control of	Frequency and range	Frequency and range

1.3. ACCESSORIES

The PM 5141 and PM 5142 synthesizers are delivered with the following accessories:
- a wallet containing two fuses, 180 mAT* (230 V) and 310 mAT* (115 V)
- a mains cable
- a manual

Optional accessories:
- B.C.D. (binary-coded decimal) programming kit PM 9689/01; this is a printed wiring board which can be mounted within the synthesizers to allow remote programming of frequencies from switch contacts computer logic sources, etc.

1.4. DESCRIPTION OF THE BLOCK DIAGRAM

The synthesizer circuits consist of four main sections as shown in the block diagram, Fig. 1. These sections are:

1. A frequency generator comprising a stable quartz crystal oscillator operating at 18 MHz, followed by two frequency divider networks, one to obtain the numerically-selected read-out and the other to enable pushbutton selection of the frequency range.
2. A numerical derivation circuit for the sine-wave signal. In this circuit a generator produces a programme to derive the time/amplitude function to feed a digital-to-analogue converter.
3. An analogue output stage for the sine-wave signal.
   This comprises the digital-to-analogue converter, the output of which is amplified and applied to a low-pass filter before it is fed via the attenuator to the sine-wave output socket.
4. An analogue output for the square-wave signal comprising an amplifier circuit.

The PM 5142 has an additional analogue frequency generator stage to provide for the 100 kHz to 1 MHz range.

*) Delayed action

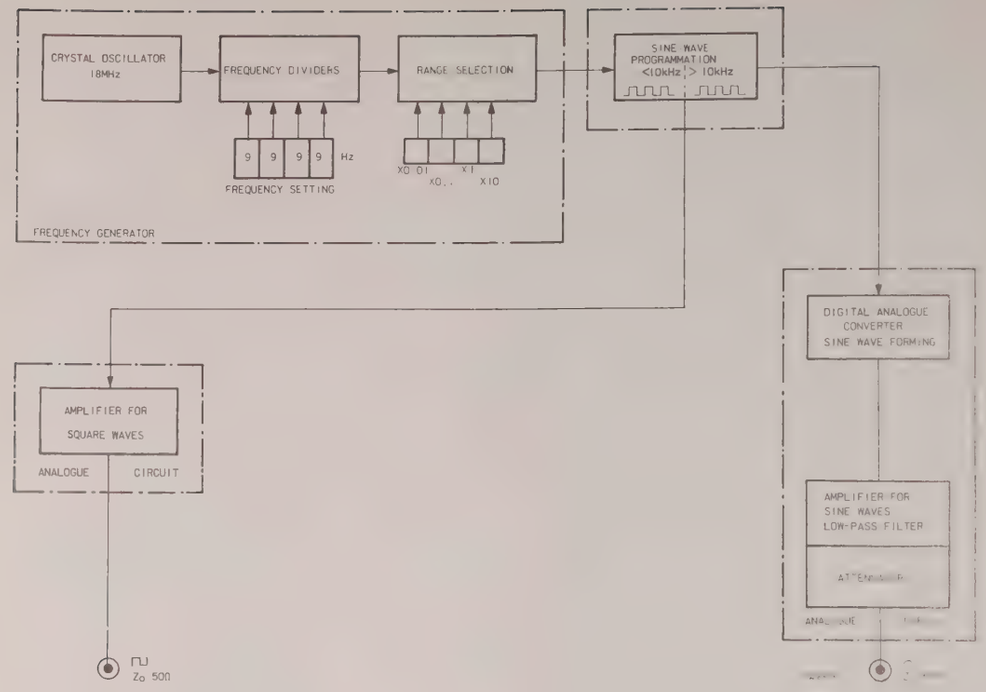


Fig. 1a. Block diagram PM 5141

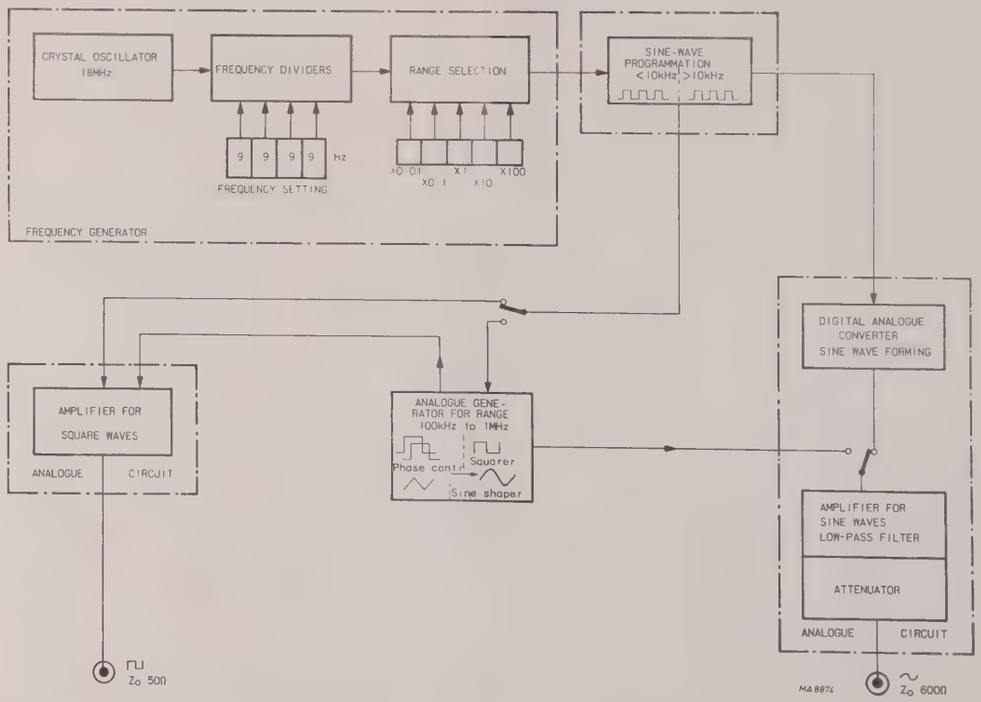


Fig. 1b. Block diagram PM 5142

2. Directions for use

2.1. INSTALLATION

Before any other connection is made, the protective earth terminal must be connected to a protective conductor (see section 2.1.3. Earthing).

2.1.1. Safety Regulations (see IEC 348 or VDE 0411)

Before connecting the instrument to the mains, visually check the cabinet, controls and connectors, etc., to ascertain whether any damage has occured in transit. If any defects are apparent, do not connect the instrument to the mains.
Always disconnect the instrument from the mains before removing any protective covers.
Any maintenance and service work necessary with the instrument switched on, should only be performed by a qualified technician.
The mains connector must only be plugged into an earthed mains socket.
Do not make this safety protection ineffective; for example, by the use of an extension cable without protective conductor.

2.1.2. Position

The instrument may be used horizontal or in sloping position by hinging out the tilting brackets.
Do not position the instrument on any surface which produces or radiates heat, or in direct sunlight.
Ensure that the ventilation holes in top and bottom plates are free from obstructions.

NOTE: Some initial tension is normal when positioning the brackets.

2.1.3. Earthing

Before switching on, the instrument must be earthed in conformity with the local safety regulations, via the three-core mains cable.
(See also section 2.1.1. Safety Regulations).

The cabinet socket (⊥) at the rear should on no account be used to connect a protective conductor.
The cabinet potential of the instrument is connected to the protective conductor.
The circuit–earth potential is floating.

WARNING:

Any interruption of the protective conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.

When an instrument is brought in from a cold environment for use in a warm room condensation may cause a hazardous condition. Therefore, ensure that the earthing requirements are strictly adhered to.

2.1.4. Connection to the mains

Before inserting the mains plug into the mains socket, ensure that the instrument is set to the local mains voltage. The instrument must be connected only to an a.c. supply. On delivery the instrument is set to 220 V ± 10 %. If the instrument is to be used on 127 V ± 10 % supply, proceed as follows:

– Unplug the mains connector
– remove the voltage selector locking-plate screw at the rear of the instrument
– mount the inverter plug opposite the relevant position
– affix the locking plate
– fit the 310 mA fuse
– close the instrument.

Adaptation to 117 V or 240 V mains is possible by modifying the transformer tappings. To gain access to the mains transformer remove the two rear cover screws of the instrument. The connections are shown in the figure below:

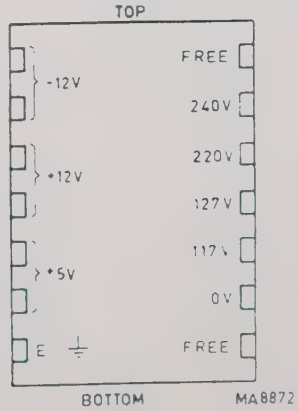


Fig. 2. Transformer connections

2.2. CONTROLS AND SOCKETS

2.2.1. Front panel (see fig. 3.)

Text plate indication	*Function*
POWER ON	Mains switch; switched on in upper position
⊓⊔ /Z_o50 Ω	Square-wave output on TTL-Level; 5 V_{pp} fixed, on 50 Ω
FREQUENCY Hz	Frequency selection: – with 4 coded thumb-wheel switches – resolution selection of thumb-wheel switches: – 4 ranges for PM 5141 – 5 ranges for PM 5142
x0.01	0.01 Hz to 99.99 Hz
x0.1	0.1 Hz to 999.9 Hz
x1	1 Hz to 9999 Hz
x10	10 kHz to 99.99 kHz
x100 (PM 5142 only)	100 kHz to 999.9 kHz
SELECT LOWER RANGE	Red warning light; indicates unsuitable resolution (e.g. left thumb-wheel switch in 0 position in range x10 and x100)
∼ /Z_o 600 Ω	Sine-wave output; 5 V_{pp} variable, on 600 Ω
AMPLITUDE	Potentiometer; left-hand stop provides 20 dB attenuation
10 V_{pp} max.	Maximum open circuit voltage of 10 V_{pp} sine wave signal
ATTENUATION dB	Sine wave output attenuation by 3 fixed steps of 10 dB, 10 dB and 20 dB. The maximum possible attenuation: 10+10+20 dB (steps) plus 20 dB (continuous) makes 60 dB.

2.2.2. Rear panel (see fig .4)

Rear panel indication	*Function*
⊥	Connection socket for cabinet potential. Note: this is NOT a connection point for safety earth !
310 mAT/180 mAT	Mains overload protection fuse. 117 V or 127 V a.c.: 310 mAT (delayed action) 220 V or 240 V a.c.: 180 mAT (delayed action)
230/115	Mains voltage selector
REMOTE CONTROL	Hole for 24-way plug of PM 9689/01 (covered by blanking plate). PM 9689/01 is an optional accessory allowing remote selection of the output frequency.

Fig. 3. Front view

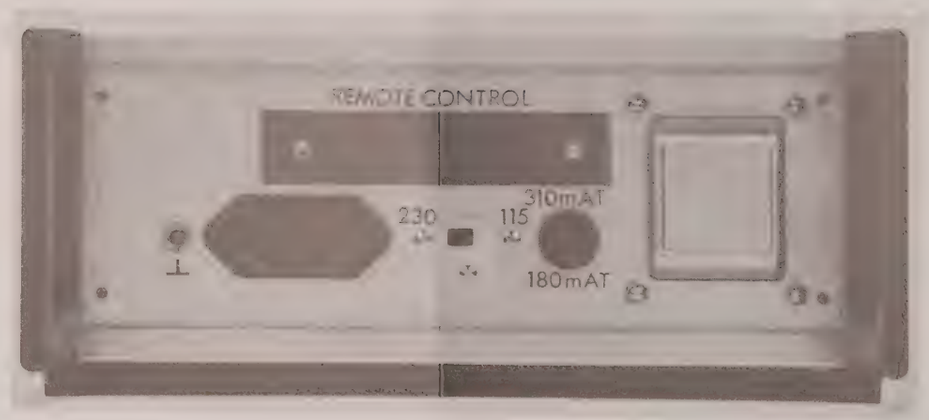


Fig. 4. Rear view

2.3. OPERATION

– Ensure that the instrument is connected to the mains in accordance with section 2.1.
– Switch on by operating POWER ON (upwards).
– Allow a warm-up period of at least 15 minutes so that the instrument conforms with the data given in section 1.2.
– Connect outputs:
  . socket 5 V/50 Ω: square wave
  . socket 5 V/600 Ω: sine wave
– Set the frequency required by means of the 4 coded thumb-wheel switches and the range selector unit. A red light (SELECT LOWER RANGE) indicates unsuitable resolution: e.g. position 0 for left thumb-wheel switch in ranges, x10 and x100.
– Adjust the attenuation required for the sine-wave signal by means of the 10-10-20 dB pushbutton unit and the 0 to 20 dB potentiometer.

Note: It is possible to check the performance of the instrument by connecting an oscilloscope to the front panel outputs and operating each control.

2.3.1. BCD Programming option

The optional kit PM 9689/01 consists of
– a remote control board
– a spacer
– a screw
– a nut
– a washer

The remote control board can be mounted within the synthesizers PM 5141 and PM 5142 to provide a remote BCD programming facility.

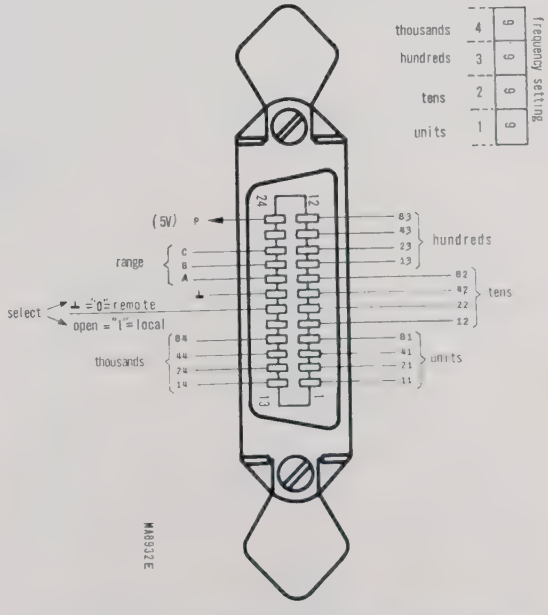
External inputs to this board from a programming unit are via a 24-way amphenol socket on the synthesizer rear panel. Choice of 'remote' or 'local' frequency programming is made via a logic signal on pin 18 of this socket. Connections 1 to 16 take over the function of the front-panel frequency selector thumb-wheel switches. Connections 1 to 4 enable binary coding of the Units digit, 5 to 8 the Tens digit, 9 to 12 the Hundreds digit and 13 to 16 the Thousands digit. (See Fig. 5.).

TABELE 1

Amphenol socket connections				
1	2	3	4	Units
(5)	(6)	(7)	(8)	Tens
(9)	(10)	(11)	(12)	Hundreds
(13)	(14)	(15)	(16)	Thousands

Digit selected	Binary code			
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

Truth table for frequency selection socket connections



– Frequency programming: 4x4 wires positive logic
– Range programming: wires A; B; C positive logic

Fig. 5. Lay-out of 24-way plug

Range selection is controlled by signals on points 20, 21 and 22 according to table 2:

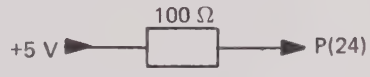
TABLE 2

Range	Pin 20	Pin 21	Pin 22
x0.01	0	0	0
x0.1	1	0	0
x1	0	1	0
x10	1	1	0
x100	0	0	1

Truth table for range selection socket connections

TABLE 3

Inputs	Required standard TTL-loads (1 standard TTL-load ≙ 1,6 mA	Contacts
4x4 BCD	each 1	1 to 16
A	2	20
B	1	21
C	3	22
Select	5	18



Selection manual control or remote programming is governed by the logic state of the signal on pin 18. In the 'high' state (logic 1), local programming by means of the normal front-panel controls is effected. In the 'low' state (logic 0, by internal interconnection to earth on pin 19 in the socket) remote programming is effected from switch contacts, computer logic sources, etc.

Remote programming can be achieved simply by mechanical switches, but greater flexibility is obtained by the additional use of a diode matrix. As the demands on the programming facility may change, electronic switches, such as those used in the S&I logic system programmer on an F1 card (code number 5322 216 24017), may be used in place of the mechanical switches.

Alternatively, computer logic pulses can be used to provide the input signals to the 24-way socket. The computer logic must be positive logic and provide the inputs listed in Table 3.

Mounting instructions (see Fig. 6.)

1. Remove the 4 screws in the 2 supports on the rear panel.
2. Slide the ornamental strips from the cabinet.
3. Remove top and bottom plates.
4. Remove the cover plate (2 screws) labelled REMOTE CONTROL at the rear of the instrument. Keep screws and washers.
5. Remove the solder from the hole in the mains circuit board (Fig. 6).
6. Fit the spacer to the main circuit board (washer and nut at soldering side).
7. Connect the cables with the multiple plugs in accordance with Fig. 6. Make sure that the blue and red dots on the plugs match the dots on the main circuit board.
   - Remove multipole plug T.
   - Remove multipole plug S from connector P' and plug it on to connector S' on the remote-control board.
   - Plug the multipole plugs of the cables coming from P, Q and R on the remote control board on to connectors P', Q' and R' on the main circuit board.
8. Fit the board with the 24-pole socket on to the rear panel by means of the screws and washers remaining from step 4. The component side must face the top of the instrument.
9. Screw the remote control board to the spacer.
10. Close the instrument in accordance with inverted steps 3, 2 and 1.

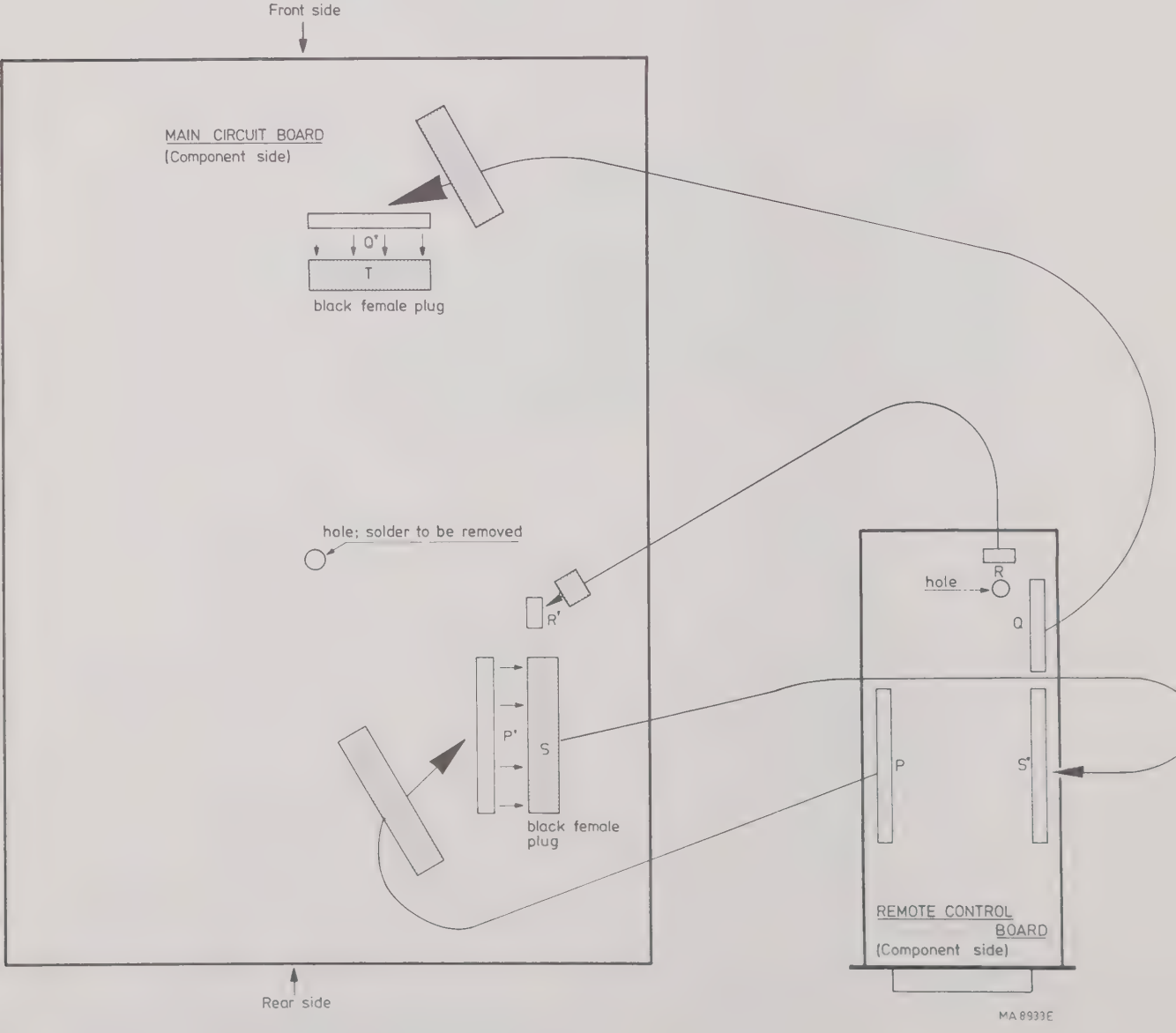


Fig. 6. Connections to be made (overall view of connections)

Gerätehandbuch

1. Allgemeiner Teil

1.1. EINLEITUNG

Die Sinus-Rechteck Generatoren PM 5141 und PM 5142 (mit erweiterem Frequenzbereich), arbeiten nach dem Prinzip der digitalen Signalsynthese. Das Sinussignal wird zunächst in Form einer Binärzahlenfolge aufbereitet und dann in den analogen Bereich umgesetzt.
Der Frequenzumfang der genannten Signale erstreckt sich von 0,01 Hz bis 100 kHz bei Ausführung PM 5141 und von 0,01 Hz bis 1 MHz bei PM 5142. Die Frequenz der erzeugten Signale ist quarzstabilisiert.
Jeder Generator hat für das Sinus- und Rechtecksignal getrennte Ausgänge.

Besondere Eigenschaften:

- umfangreicher Frequenzbereich von 0,01 Hz bis 1 MHz
- hohe Frequenzauflösung (10^{-4})
- gute Oberwellenunterdrückung von > 50 dB
- geringer Rauschpegel
- Gleichtaktunterdrückung durch erdfreie Ausgänge
- ein von der Ausgangsfrequenz unabhängiger Tastgrad
- Einstellzeit entspricht einer Periodendauer der gewählten Frequenz im Bereich von 0,01 Hz bis 100 kHz
- fernprogrammierbar unter Verwendung von Sonderzubehör.

Die generatoren sind auf den Gebieten der Ton- und Niederfrequenztechnik, des Servomechanismus, der Elektromedizin und der Schwingungsmesstechnik anwendbar.
Beide Generatoren sind in einem freistehenden Gehäuse (4/8 der 19'' Standardbreite) erhältlich.
Der Metallkasten für zwei Einheiten Breite (89 mm Höhe) hat an der Frontseite zwei Traggriffe.
An der Rückseite befinden sich zwei Stützen die vertikale Verwendung ermöglichen.
Zur Erleichtung der Bedienung sind zwei Klappbügel vorgesehen, die Schrägstellung des Gerätes erlauben.

1.2. TECHNISCHE DATEN

Allgemeine Hinweise:

- Nur Angaben mit Toleranzen oder Grenzwerten können als garantierte Daten angesehen werden. Daten ohne Toleranzen, d.h. ohne Fehlergrenzen, sind informative Daten und werden nicht garantiert.
- Fehlerangaben gelten bei einer Betriebstemperatur von 23 °C und nach einer Anheizzeit von 15 Minuten
- Prozentuale und absolute Fehler sind auf den jeweils angegebenen Referenzwert bezogen.

KENNGRÖSSEN	PM 5141	PM 5142
Signalform	Sinusförmig Rechteckig	Sinusförmig Rechteckig
Frequenzbereich	0,01 Hz bis 100 kHz	0,01 Hz bis 1 MHz
Frequenzeinstellung	4 Daumenräder	4 Daumenräder
Frequenzauflösung	10^{-4} vom eingestellten Bereich	10^{-4} vom eingestellten Bereich
Frequenzgenauigkeit	5.10^{-5}	5.10^{-5}
Frequenzstabilität	10^{-6}	10^{-6}
Frequenzdrift	$< 10^{-5}$/°C	$< 10^{-5}$/°C
Netzteil	127 V/220 V ± 10% oder +6 % 117V ± 10%/240V +10% 50/60 Hz	127 V/220 V ± 10% oder +6 % 117 V ± 10%/240 V +10 % 50 /60 Hz
Temperaturbereich	0 °C bis +50 °C	0 °C bis +50 °C

1.2.1. Rechtecksignal	PM 5141	PM 5142
Tastfolgefrequenz	0,01 Hz bis 100 kHz in 4 Bereichen	0,01 Hz bis 1 MHz in 5 Bereichen
Anstiegzeit (10 bis 90%)	$\leqslant$ 50 ns	$\leqslant$ 50 ns
Abfallzeit (10 bis 90%)	$\leqslant$ 50 ns	$\leqslant$ 50 ns
Nachschwingen	$\leqslant$ 1 %	$\leqslant$ 1 %
Tastgrad	50 %	50 %
Tastgrad-Toleranz		
$f \leqslant 10$ kHz	$\leqslant$ 100 ns	$\leqslant$ 100 ns
10 kHz $\leqslant f \leqslant$ 100 kHz	$\leqslant$ 0,5 %	$\leqslant$ 0,5 %
100 kHz $\leqslant f \leqslant$ 1 MHz	–	$\pm$ 50 ns
Ausgang $\sqcap\!\sqcup$ / Z_o 50 Ω	BNC-Buchse gegen Gehäuse isoliert	BNC-Buchse gegen Gehäuse isoliert
Ausgangsspannung (Last = 50Ω)	+5 V	+5 V
Ausgangsleerlaufspannung	$\geqslant$ 10 V	$\geqslant$10 V
Ausgangsimpedanz	50 Ω $\pm$ 5 %	50 Ω $\pm$ 5 %

1.2.2. Sinussignal		
Frequenzbereich	0,01 Hz bis 100 kHz in 4 Bereichen	0,01 Hz bis 1 MHz in 5 Bereichen
Spektrale Reinheit		
– Bereiche 100 Hz; 1 kHz; 10 kHz		
– Unterdrückung von Oberschwingungen	$\geqslant$ 50 dB	$\geqslant$ 50 dB
– Unterdrückung von Nichtharmonischen	$\geqslant$50 dB	$\geqslant$ 50 dB
– Bereich 10 kHz bis 100 kHz		
– Unterdrückung von Oberschwingungen	$\geqslant$ 40 dB	$\geqslant$ 40 dB
– Unterdrückung von Nichtharmonischen	$\geqslant$40 dB	$\geqslant$ 40 dB
– Bereich 100 kHz bis 1 MHz		
– Unterdrückung von Oberschwingungen	–	$\geqslant$40 dB
– Unterdrückung von Nichtharmonischen	–	$\geqslant$ 40 dB bei 1 kHz vom Träger
Klirrfaktor 10 Hz - 10 kHz	0,8 %	0,8 %
Klirrfaktor 100 kHz - 1 MHz	–	$\leqslant$ 1 %
Ausgangsleerlaufspannung (Spitze-Spitze)	10 V	10 V
Ausgangsspannung (Last = 600 Ω) (Spitze-Spitze)	5 V	5 V
Ausgang $\sim$/Z_0 600 Ω	BNC-Buchse, gegen Gehäuse isoliert	BNC-Buchse, gegen Gehäuse isoliert
Ausgangsimpedanz	600 Ω $\pm$ 2% + 15μH $\pm$ 20 %	600 Ω $\pm$ 2% + 15μH $\pm$20 %
Abschwächung	0 bis 60 dB	0 bis 60 dB
– mit Drucktasten stufenweise	10-10-20 dB	10-10-20 dB
– stufenlos	20 dB	20 dB

		PM 5141	PM 5142
	Toleranz der Abschwächung		
	– mit Drucktasten, stufenweise	0,2 dB	0,2 dB
	– stufenlos	± 2 dB	± 2 dB
	Amplitudenänderung in Abhängigkeit der Frequenz (Ausgang 600Ω/max. Ampl.)		
	0.01 Hz ⩽ f < 10 kHz	0,5 %	0,5 %
	10 kHz ⩽ f < 100 kHz	1,0 %	1,0 %
	100 kHz ⩽ f < 1 MHz	–	2,0 %
1.2.3.	**Warnlicht bei Bereichsüberschreitung**	Vorhanden	Vorhanden
1.2.4.	**Abmessungen**	**PM 5141**	**PM 5142**
	Einschubgestellbreiten	½	½
	Höhe	100 mm	100 mm
	Breite	216 mm	216 mm
	Tiefe	355 mm	355 mm
	Gewicht	3,2 kg	3,2 kg
1.2.5.	**Für Fernsteuerung von Bereich und Frequenz**	Vorbereitet	Vorbereitet

1.3. ZUBEHÖR

Folgendes Zubehör wird bei PM 5141 und PM 5142 mitgeliefert:

– zwei Sicherungen in einem Beutel, 180 mAT(230 V) und 310 mAT (115 V)
– eine Netzzuleitung
– eine Anleitung

Sonderzubehör:

– eine BCD (binär-codierte dezimale) Programmierausrüstung PM 9689/01, Sie besteht aus einer Printplatte die sich innerhalb der Gehäuse montieren lässt. Damit ist die Fernsteuerung der Frequenz durch Schaltkontakte oder aus Komputerlogik-Quellen usw. möglich.

1.4. BESCHREIBUNG DES BLOCKSCHALTBILDS

Die Generatorschaltung besteht aus 4 Hauptteilen; siehe Blockschaltbild, Fig. 1.

1.4.1. Ein Frequenzgenerator mit einem stabilen 18 MHz-Quarzoszillator, gefolgt von zwei Frequenzteiler-Netzwerken. Das eine dient der numerischen Ablesung, das andere der Drucktastenwahl des Freqeunzbereichs.

1.4.2. Eine Schaltung zur digitalen Synthese

Dieser Funktionsblock erzeugt im Rythmus der Taktimpulse des Frequenzgenerators Binärwerte als Messzahlen für die Momentanwerte des Sinussignals.

1.4.3. Eine analoge Ausgangsschaltung für das Sinussignal

Sie enthält den Digital/Analog Umsetzer, dessen Ausgangssignal vorher verstärkt, ein Tiefpassfilter passiert und über einen Abschwächer an die Ausgangsbuchse $\sim/Z_o$ 600 Ω gelangt.

1.4.4. Ein Analog-Ausgang für das Rechtecksignal, bestehend aus einer Verstärkerschaltung.
Der Generator PM 5142 besitzt zusätzlich eine Frequenzgenerator Stufe für den 100 kHz bis 1 MHz Bereich.

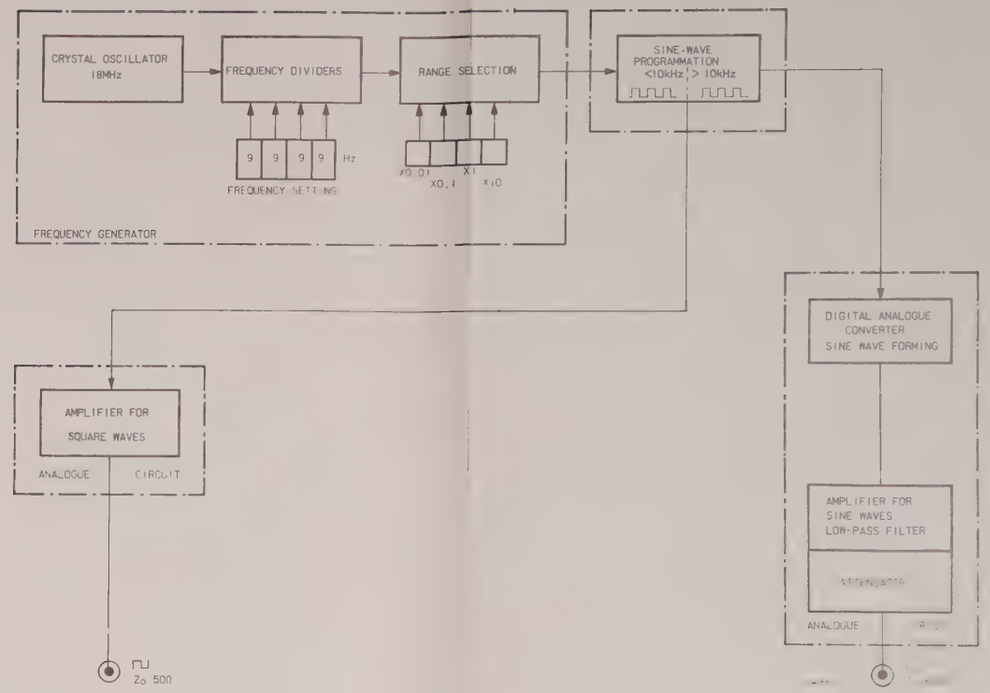


Fig. 1a. Blockschaltbild PM 5141

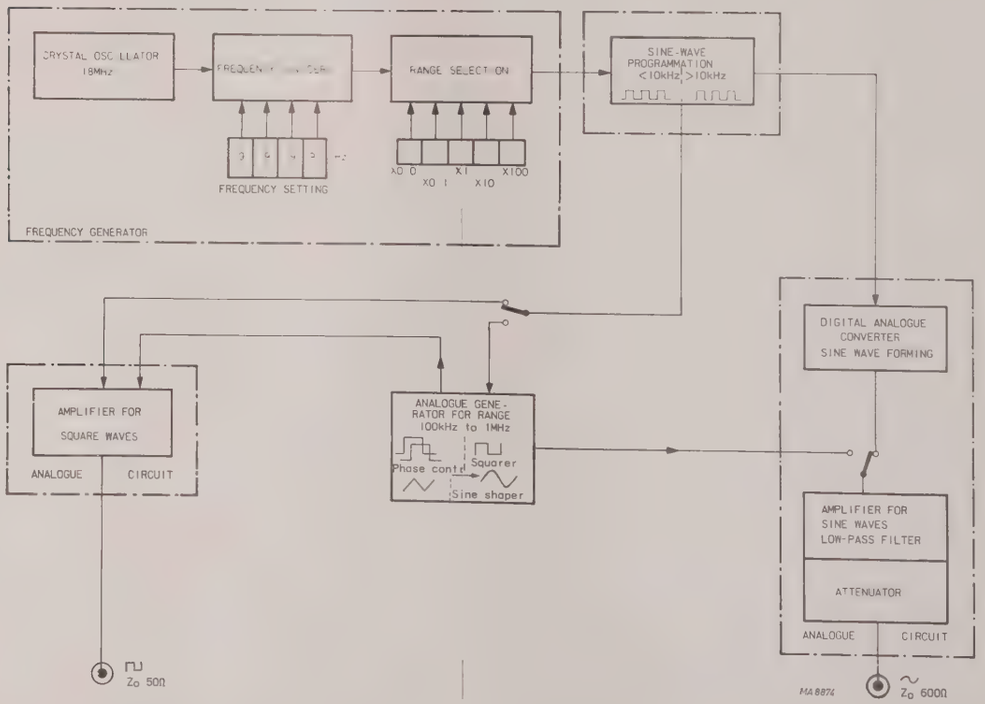


Fig. 1b. Blockschaltbild PM 5142

2.Vorbereitungsanweisungen

2.1. WICHTIGE SICHERHEITSTECHNISCHE HINWEISE

Dieses Gerät has das Werk in sicherheitstechnisch einwandfreiem Zustand verlassen. Zur Erhaltung dieses Zustands und seines gefahrlosen Betriebs empfehlen wir, die nachfolgenden Hinweise sorgfältig zu beachten.

2.1.1. Vor dem Anschliessen

Nezspannung

Es ist sicherzustellen, dass die eingestellte Betriebsspannung des Geräts und die Nenn-Netzspannung übereinstimmen.

Schutzklasse

Dieses Gerät ist ein Gerät der Schutzklasse I (Schutzleiteranschluss) gemäss IEC 348 oder VDE 0411. Die mitgelieferte Netzzuleitung enthält einen Schutzleiter. Ausser in besonders zugelassenen Räumen darf der Netzstecker nur in Schutzkontaktsteckdosen eingeführt werden.
Jede Unterbrechung des Schutzleiters, innerhalb oder ausserhalb des Geräts, ist unzulässig.

2.1.2. Reparatur und Wartung

Fehler und aussergewöhnliche Beanspruchungen

Wenn anzunehmen ist, dass ein gefahrloser Betrieb nicht mehr möglich ist, so its das Gerät ausser Betrieb zu setzen und gegen unabsichtlichen Betrieb zu sichern.
Dieser Fall tritt ein,
– wenn das Gerät sichtbare Beschädigungen aufweist,
– wenn das Gerät nicht mehr arbeitet,
– nach Überbeanspruchungen jeglicher Art (z.B. Lagerung, Transport), die die zulässigen Grenzen überschreiten.

Öffnen des Geräts

Beim Öffnen von Abdeckungen oder Entfernen von Teilen mit Werkzeug können spannungsführende Teile freigelegt werden. Auch können Anschlusstellen spannungsführend sein.
Vor dem Offnen des Geräts muss das Gerät von allen Spannungsquellen getrennt sein.
Wenn danach eine Kalibrierung, Wartung oder Reparatur am geöffneten Gerät unter Spannung unvermeidlich ist, so darf das nur durch eine Fachkraft geschehen, welche die damit verbundenen Gefahren kennt.
Kondensatoren im Gerät können noch geladen sein, selbst wenn das Gerät von allen Spannungsquellen getrennt wurde, die Schaltbilder sind zu beachten.

Sicherungen

Es dürfen nur die vorgeschriebenen Sicherungen verwendet werden.

Reparatur, Ersatz von Teilen

Reparaturen sind fachgerecht durchzuführen. Dabei ist besonders darauf zu achten, dass die konstruktiven Merkmale des Geräts nicht sicherheitsmindernd verändert werden. Inbesondere dürfen die Kriech- und Luftstrecken und die Abstände durch die Isolierung hindurch nicht verkleinert werden.
Zum Ersatz nur Original-Teile verwenden. Andere Ersatzteile sind nur zulässig, wenn dadurch die sicherheitstechnischen Eigenschaften des Geräts nicht verschlechtert werden.

2.2. AUFSTELLEN

Das Gerät darf in horizontaler Lage oder mit Hilfe der Klappbügel schräge gestellt betrieben werden. Die Belüftungs-Löcher im Boden und Deckel dürfen nicht verdeckt werden.
Es ist darauf zu achten, dass das Gerät nicht auf andere Wärmequellen gestellt oder übermässiger Wärmeeinstrahlung ausgesetzt wird.

BEMERKUNG: Beim Aufklappen der Bügel ist eine gewisse Schwergängigkeit in Kauf zu nehmen; Sie dürfen jedoch niemals gewaltsam über 90° gegenüber der Bodenplatte nach aussen gedrückt werden.

2.3. ERDEN

Das Gerät muss den örtlichen Vorschriften entsprechend geerdet werden. Die mitgelieferte Netzzuleitung enthält einen Schutzleiter und ist mit Schutzkontaktsteckern versehen. Hierdurch wird beim Anschluss an eine Schutzkontaktsteckdose das Gehäuse des Geräts zwangsläufig mit Schutzerde verbunden.

ACHTUNG:

Der Netzanschlussstecker darf nur in eine Schutzkontaktsteckdose eingeführt werden. Diese Schutzmassnahme darf nicht unwirksam gemacht werden, z.B. durch eine unvollkommene Verlängerungsleitung!

Die Aussenkontakte der BNC-Buchsen führen das Schaltungsnullpunkt-Potential und sind **nicht** mit dem Gehäuse verbunden.
Die an der Rückseite angeordnete Gehäuseanschlussbuchse (⊥) darf auf keinen Fall als Schutzleiteranschluss verwendet werden.

2.4. NETZSPANNUNGSKONTROLLE UND ANPASSUNG; NETZANSCHLUSS

Dieses Gerät darf an Wechselspannung betrieben werden.
Es ist bei Auslieferung auf einen Netzspannungsbereich von 220 V eingestellt.
Vor dem Anschliessen an das Netz ist zu prüfen, ob der Netzspannungstransformator auf die örtliche Netzspannung (± 10 %) eingestellt ist. Die eingestellte Spannung kann an der Gehäuserückwand abgelesen werden.
Soll das Gerät auf 127 V ± 10 % umgestellt werden, ist wie folgt zu verfahren:
– Netzstecker herausziehen.
– Schraube der Spannungswähler Abdeckplatte and der Rückseite des Geräts entfernen.
– Umschalter in die zutreffende Position bringen.
– Abdeckplatte befestigen.
– 310 mA Sicherung einsetzen.
– Gerät schliessen.
Eine Anpassung an 117 V - oder 240 V - Betrieb lässt sich durch Umlöten der Netztransformator- Anschlüsse durchführen. Der Netztransformator ist nach Entfernen der Deck- und Bodenplatte zugänglich (siehe Fig. 2).
Das Gerät ist den örtlichen Sicherheitsvorschriften entsprechend an das Netz anzuschliessen. Dazu ist das Gerät über die Netzzuleitung mit einer Schutzkontaktsteckdose zu verbinden (siehe auch 2.3.).

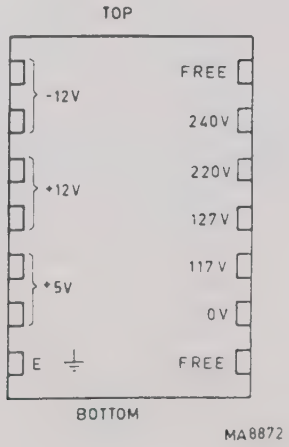


Fig. 2. Transformatoranschlüsse.

3. Betriebsanleitung

3.1. BEDIENUNGS- UND ANSCHLUSSELEMENTE

3.1.1. **Frontplatte** (siehe Abb. 3).

Textplattenbeschriftung	*Funktion*
POWER ON	Netzschalter nach oben eingeschaltet
⊓⊔/Z_o 50 Ω	Rechtecksignal Ausgang, TTL-Pegel$_{ss}$ = 5 V, fest an 50 Ω
FREQUENCY Hz	Frequenzwahl: – mit 4 codierten Daumenradschaltern – Auflösungsgrad der Daumenradschalter – 4 Bereiche bei PM 5141, 4 Drücktasten – 5 Bereiche bei PM 5142, 5 Drücktasten
x0.01	0.01 Hz bis 99.99 Hz
x0.1	0.1 Hz bis 999.9 Hz
x1	1 Hz bis 9999 Hz
x10	10 kHz 99.99 kHz
x100 (nur bei PM 5142)	100 kHz bis 999.9 kHz
SELECT LOWER RANGE	Rotes Warnlicht leuchtet im Falle unrichtiger Auflösung (z.B. Position 0 für linken Daumenradschalter im Bereich x10 und x100).
~/Z_o 600 Ω	Sinussignal Ausgang; Amplitude U_{ss} = 5 V bei 600Ω Belastung stetig einstellbar.
AMPLITUDE	Potentiometer; Linksanschlag ergibt 20 dB Abschwächung
10 V_{pp} max.	Maximale Leerlaufspannung U_{ss} = 10 V
ATTENUATION dB	Abschwächung des Sinussignals: in 3 Stufen von 10 dB, 10 dB und 20 dB. Maximale Abschwächung: 10+10+20 dB (Stufen) plus 20 dB (Stufenlos) ergibt 60 dB.

3.1.2. **Rückwand** (siehe Abb. 4)

Rückwand Beschriftung	*Funktion*
⊥	Anschlussbuchse für Gehäusepotential **Achtung:** Dies ist **kein** Anschluss für eine Berührungsschutz Erdung.
310 mAT/180 mAT	Überlastungsschutz mittels Sicherung 117 V oder 127 V Wechselspannung : 310 mAT (träge) 220 V oder 240 V Wechselspannung : 180 mAT (träge)
230/115	Netzspannungswähler
REMOTE CONTROL	Öffnung für 24-poligen Stecker vom PM 9689/01 (PM 9689/01 ist ein Sonderzubehör für die Fernwahl der Frequenz.

3.2. BEDIENUNG

– Kontrollieren ob das Gerät gemäss Abschnitt 2 an das Netz angeschlossen ist.

– Einschalten mit POWER ON (nach oben)

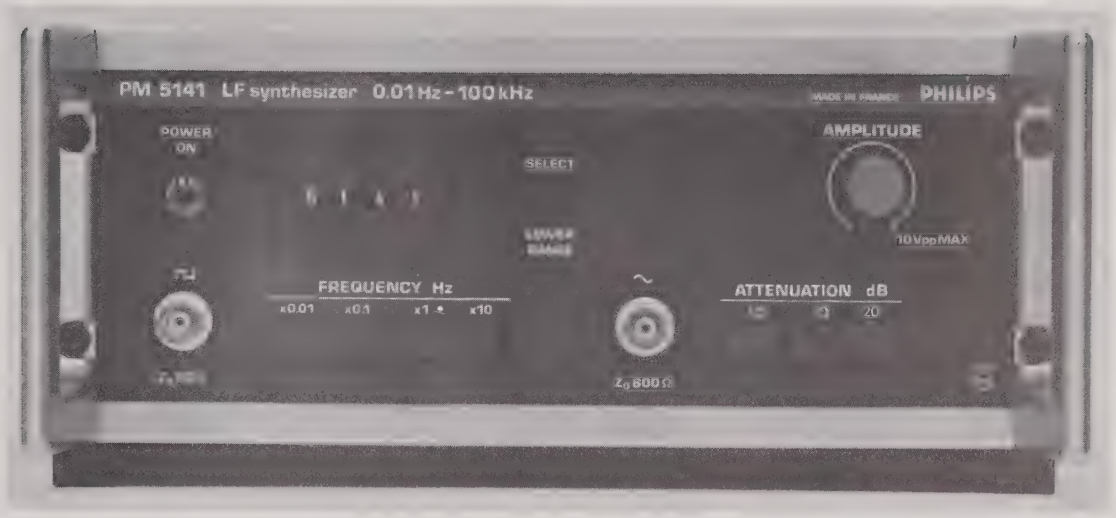


Fig. 3. Frontansicht

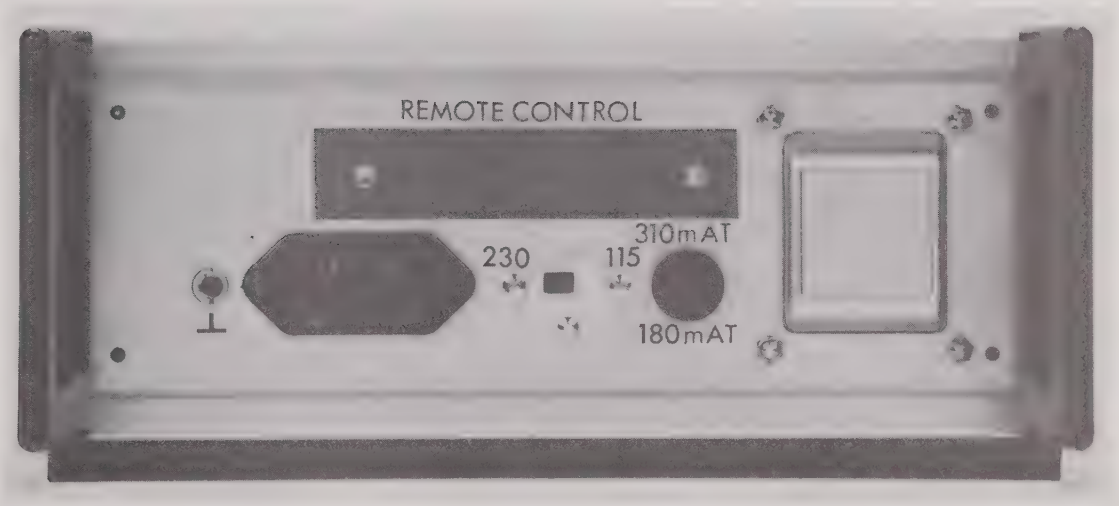


Fig. 4. Rückansicht

– Eine Einlaufzeit von mindestens 15 Minuten berücksichtigen, damit das Gerät die in Abschnitt 1.2. angegeven Daten erfüllt

– Prüfobjeckte an die Ausgänge anschliessen:
  . Buchse ⊓⊔/Z_o 50 Ω : Rechtecksignal
  . Buchse ~ /Z_o 600Ω: Sinussignal

– Mit den kodierten Daumenradschaltern und der Bereichswahleinheit die gewünschte Frequenz einstellen Rotes Licht (SELECT LOWER RANGE) warnt im Falle unzweckmässiger Einstellung der Frequenz vor unrichtiger Auflösung, z.B.: Position 0 für Linken Daumenradschalter in Bereichen x10 und x100.

– Die für das gewünschte Sinussignal erforderliche Abschwächung mit Hilfe der 10-10-20 dB Drucktasten und des 0-20 dB Potentiometers einstellen.

Bemerkung: ggf. die Funktion des Geräts mit einem Oszillografen prüfen.

3.3. BCD-PROGRAMMIERAUSRÜSTUNG

Das Sonderzubehör PM 9689/01 enthält:
– eine Printplatte
– ein Abstandstück
– eine Schraube
– eine Mutter
– eine Unterlegscheibe

Die Printplatte kann im Innern des Gehäuses der Generatoren PM 5141 und PM 5142 untergebracht werden. Über einen 24-poligen Amphenolstecker an der Rückseite des Generators gelangen Signale von einer externe Programmiereinheit an die Printplatte. Mit einem Logiksignal an Kontakt 18 der Steckverbindung kann zwischen Fernbetrieb und lokaler Betätigung gewählt werden. Die Kontakte 1 bis 16 übernehmen der frontseitigen Frequenzwahl Daumenradschalter. Die Kontakte 1 bis 4 dienen der Binärkodierung der Einer, 5 bis 8 der Zehner, 9 bis 12 der Hunderter und 13 bis 16 der Tausender (siehe Fig. 5.).

TABELLE 1

Ziffer gewählt	Amphenol Steckverbindungen 1	2	3	4	
	(5)	(6)	(7)	(8)	Einer Zehner
	(9)	(10)	(11)	(12)	Hunderter
	(13)	(14)	(15)	(16)	Tausender
	Binärkode				
0	0	0	0	0	
1	1	0	0	0	
2	0	1	0	0	
3	1	1	0	0	
4	0	0	1	0	
5	1	0	1	0	
6	0	1	1	0	
7	1	1	1	0	
8	0	0	0	1	
9	1	0	0	1	

Wahrheitstabelle für Frequenzwahl Steckverbindungen

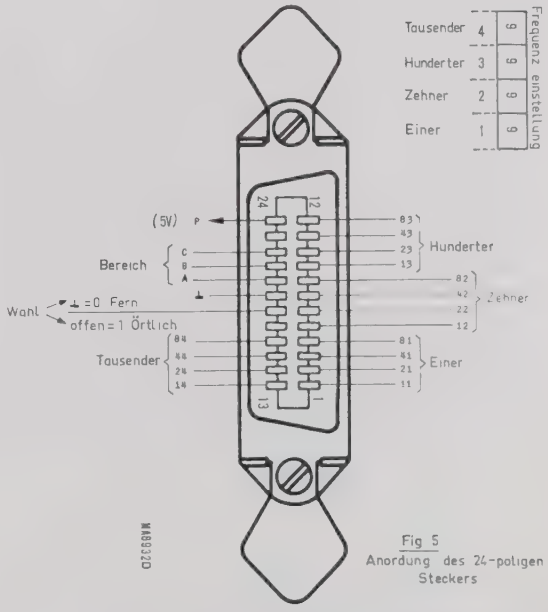


Fig 5
Anordung des 24-poligen Steckers

Frequenzprogrammierung: 4x4 Drähte Positive Logik
Bereichsprogrammierung: Drähte A, B, C Positive Logik

Fig. 5. Anordnung des 24-poligen Steckers

Der Bereich wird mit Signalen an den Kontakten 20, 21 und 22 (gemäss Tabelle 2) gewählt

TABELLE 2

Bereich	Kontakt 20	Kontakt 21	Kontakt 22
x0.01	0	0	0
x0.1	1	0	0
x1	0	1	0
x10	1	1	0
x100	0	0	1

Wahrheitstabelle für Bereichswahl Steckverbindungen

TABELLE 3

Eingänge	Verursachte Standard-TTL-Belastungen (≙ 1,6 mA)	Kontakte
4 mal 4 BCD	je 1	1 bis 16
A	2	20
B	1	21
C	3	22
Select	5	18

Der Logikzustand des Signals an Kontakt 18 entscheidet ob lokale Betätigung oder Fernprogrammierung wirksam ist.
Im Zustand "hoch" (Logik 1) wird mit den betreffenden Bedienungselementen lokale Programmierung bewirkt.
Im Zustand "niedrig" (Logik 0, durch internen Erdanschluss an Kontakt 19) is Fernprogrammierung durch Schaltkontakte, Komputerlogik-Quellen usw. möglich.

Die Fernprogrammierung kann einfach mit mechanischen Schaltkontakten ausgeführt werden, aber eine grössere Anpassungsfähigkeit wird durch zusätzlichen Einsatz einer Diodenmatrix erlangt.
Wegen der sich möglicherweise ändernden Anforderungen an die Programmierausrüstung, können anstelle der mechanischen Schalter, elektronische Schalter wie sie im S & I Logik System Programmierer auf einer F1 Karte (Kodennummer 5322 216 24017) verwendet werden, eingesetzt werden.
Eine andere möglichkeit ist Komputerlogik Impulse als Eingangssignale and den 24-poligen Stecker zu legen.
Die Komputerlogik muss positiv sein und muss die in Tabelle 3 angegebenen Eingänge liefern.

Montage anleitungen (siehe Fig. 6)

1. 4 Schrauben in den beiden Stützen an der Rückwand lösen
2. Hintere Zierstreifen vom Gehäuse abziehen
3. Deck- und Bodenplatte entefrnen
4. Abdeckplatte REMOTE CONTROL (2 Schrauben) an der Rückwand des Geräts entfernen. Schrauben und Unterlegscheiben aufheben
5. Lot von der Hauptprintplatte lösen (Fig. 6)
6. Abstandstück an der Hauptprintplatte befestigen (Unterlegscheibe und Mutter kommen auf der Seite der Leiterbahnen)
7. Kabel gemäss Fig. 6. an die mehr-poligen Stecker anschliessen.
   Es ist darauf zu achten, dass die blauen und roten Punkte an den Steckern mit den Punkten auf der Hauptprintplatte übereinstimmen.
   – Mehrpoligen Stecker T entfernen
   – Mehrpoligen Stecker S aud Buchse P' ziehen und in Buchse S' auf der Fernsteuer-Printplatte stecken
   – Die mehrpoligen Stecker von P, Q und R der Fernsteuer-Printplatte in die Buchsen P', Q', und R' der Hauptprintplatte stecken.
8. Printplatte mit dem 24-poligen Stecker an die Rückwand montieren mit den zwei aufgehobenen Schrauben und Unterlegscheiben. Die bestückte seite muss nach oben gerichtet sein.
9. Fernsteuer-Printplatte an das Abstandstück schrauben
10. Im Umgekehrter Reihenfolge der ersten drei Handlungen das Gerät schliessen.

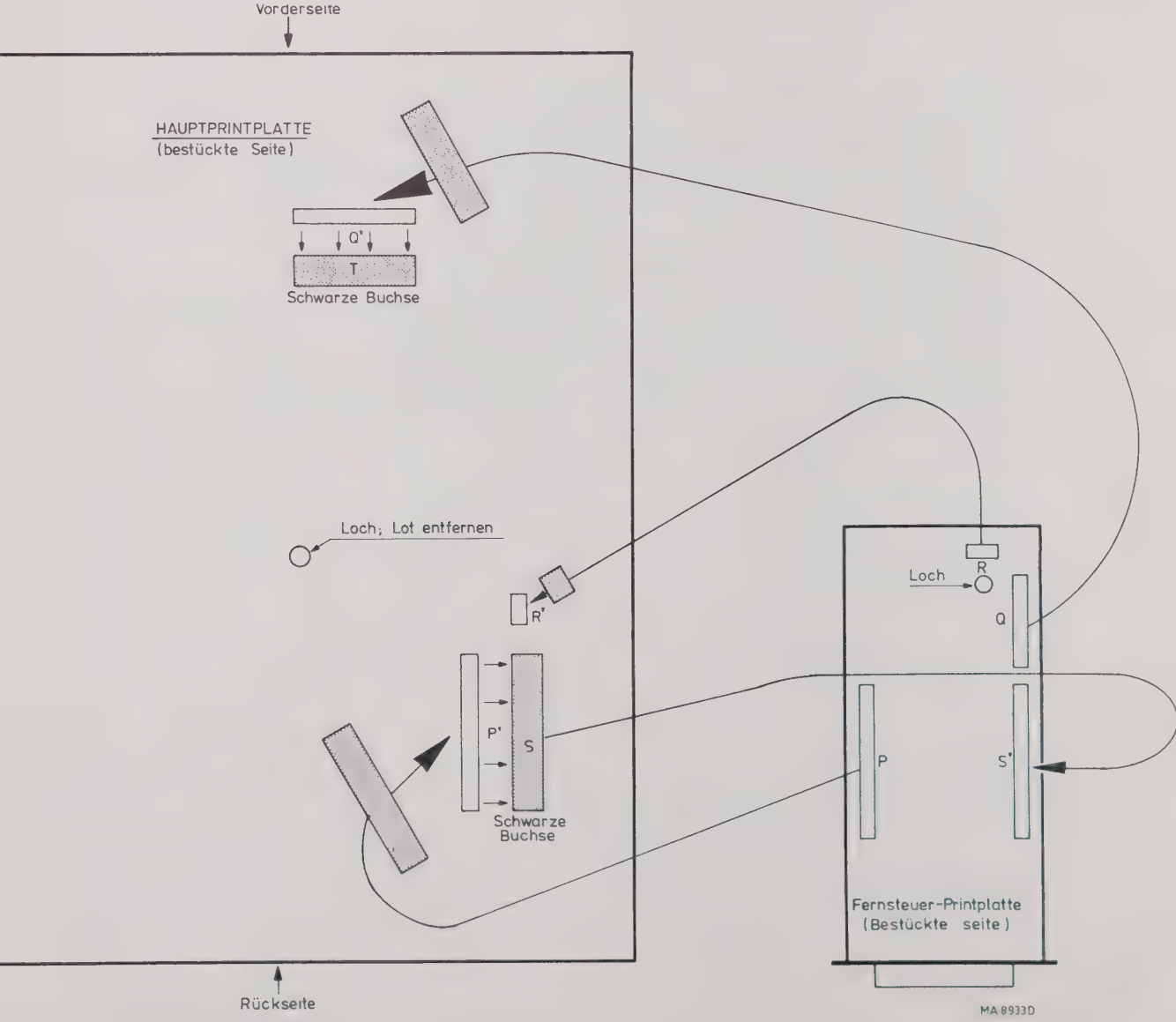


Fig. 6. Auszuführende Anschlüsse

Mode d'emploi

1.Généralités

1.1. INTRODUCTION

Les générateurs de fréquence synthétisée PM 5141 et PM 5142 (avec gamme de fréquence supplémentaire) sont basés sur le principe de la conversion directe permettant de réaliser une sinusoïde à partir d'un programme élaborant la fonction temps/amplitude. La précision de fréquence de l'onde produite par le générateur dépend de l'oscillateur cristal de référence.
Dans cette optique, il n'y pas de rapport de phase entre l'oscillateur et les ondes élaborées.
Chaque générateur de fréquence synthétisée présente deux sorties directes, un signal rectangulaire et un autre sinusoïdal couvrant les fréquences 0,01 à 100 kHz sur 4 gammes pour le PM 5141 et une gamme supplémentaire (100 kHz à 1 MHz) pour le PM 5142.

Propriétés:

- frequence étendue (0,01 à 1 MHz) et grande résolution (10^{-4}) d'application utile en audio-fréquence, servo-méchanisme, électro-médicale vibration et pour des utilisations plus générales.
- réjection harmonique de −50 dB.
- fait appel au principe numérique, qui permet d'obtenir des niveaux de bruit très faibles
- des sorties flottantes assurant une forte réjection en mode commun et donc un niveau de bruit parasite faible
- un rapport cyclique indépendant de la fréquence de sortie
- un temps d'acquisition d'une période pour chaque sélection de fréquence entre 0,01 Hz et 100 kHz
- une possibilité de programmation à distance en option.

Les deux générateurs de fréquences synthétisée sont placés dans un boîtier portable (4/8 de largeur standard 19''). Le coffret métallique des deux unités (hauteur 89 mm) présente deux poignées à l'avant. A l'arrière on trouve deux supports permettant d'utiliser l'appareil verticalement.
De plus, deux étriers-supports sont disponibles et permettent d'incliner l'appareil.

1.2. CARACTERISTIQUES TECHNIQUES

Généralités

Cet appareil a été conçu et testé conformément à la norme C.E.I. 348 pour appareils de classe I. A sa livraison il répond aux règles de sécurité. La présente notice comporte les informations et les avertissements nécessaires à l'utilisateur afin d'assurer le fonctionnement de l'appareil dans les conditions de sécurité et de le maintenir conforme à la norme.
Seules les données exprimées en valeurs numériques et avec tolérance sont garanties, à condition cependant qu'un temps de chauffage de 30 minutes et une température ambiante de 23 °C ait été observé.
Les fautes relatives sont données en pourcents ou p.p.m. des valeurs réglées à moins qu'indiquées différemment.

Specifications

Caractéristiques	**PM 5141**	**PM 5142**
Fonctions	Sinusoidale Rectangulaire	Sinusoidale Rectangulaire
Gamme de fréquence	0,01 Hz à 100 kHz	0,01 Hz à 1 MHz
Choix de fréquence	4 roues moletées	4 roues moletées
Résolution pour chacune des deux formes d'onde	10^{-4} par gamme	10^{-4} par gamme
Précision de fréquence	5.10^{-5}	5.10^{-5}
Stabilité de fréquence	10^{-6}	10^{-6}
Dérive de fréquence	$< 10^{-5}/°C$	$< 10^{-5}/°C$

	Caractéristiques	PM 5141	PM 5142
	Alimentation	127 V - 220 V ± 10% ou 117 V ± 10% 240 V $^{+6\ \%}_{-10\%}$ 50/60 Hz	127 V - 220 V ±10 % ou 117 V ± 10% 240V $^{+6\ \%}_{-10\%}$ 50/60 Hz
	Température de fonctionnement	0 °C à +50 °C	0 °C à +50 °C
1.2.1.	**Signal rectangulaire**		
	Gamme de fréquence	0,01 Hz à 100 kHz en 4 gammes	0,01 Hz à 1 MHz en 5 gammes
	Temps de montée (10 à 90%)	⩽ 50 ns	⩽ 50 ns
	Temps de descente (10 à 90%)	⩽ 50 ns	⩽ 50 ns
	Suroscillation	⩽ 1 %	⩽ 1 %
	Rapport cyclique	50 %	50 %
	Précision du rapport cyclique		
	f ⩽ 10 kHz	⩽100 ns	⩽ 100 ns
	10 kHz ⩽ f ⩽ 100 kHz	⩽ 0,5 %	⩽ 0,5 %
	100 kHz ⩽ f ⩽ 1 MHz	–	± 50 ns
	Sortie	Flottante	Flottante
	Tension de sortie (50 Ω)	+5 V	+5 V
	Tension de sortie (circuit couvert)	⩾ 10 V	⩾ 10 V
	Impédance de sortie	50 Ω ± 5 %	50 Ω ± 5 %
	Protection	Contre courts-circuits	Contre courts-circuits
1.2.2.	**Forme d'onde sinusoidale**		
	Gamme de fréquence	0,01 Hz à 100 kHz en 4 gammes	0,01 Hz à 1 MHz en 5 gammes
	Pureté spectrale		
	– Gammes 100 Hz; 1 kHz; 10 kHz		
	– Niveau relatif des raies harmoniques	⩾ 50 dB	⩾ 50 dB
	– Niveau relatif des raies non-harmoniques	⩾ 50 dB	⩾ 50 dB
	– Gammes 10 kHz et 100 kHz		
	– Niveau relatif des raies harmoniques	⩾ 40 dB	⩾ 40 dB
	– Niveau relatif des raies non-harmoniques	⩾ 40 dB	⩾ 40 dB
	– Gamme 100 kHz à 1 MHz		
	– Niveau relatif des raies harmonique	–	⩾ 40 dB
	– Niveau relatif des raies non-harmonique	–	⩾ 40 dB à 1 kHz par rapport à la porteuse
	Distorsion 10 Hz - 10 kHz	0,8 %	0,8 %
	Distorsion 100 kHz - 1 MHz	–	⩽1 %
	Tension de sortie (circuit ouvert)	10 V_{cc}	10 V_{cc}
	Tension de sortie (sur 600 Ω)	5 V_{cc}	5 V_{cc}
	Sortie	Flottante	Flottante
	Impédance de sortie	600 Ω ± 2% + 15μH ± 20 %	600 Ω ± 2% + 15μH ± 20 %
	Atténuation	0 à 60 dB	0 à 60 dB
	– Boutons-poussoirs	10-10-20 dB	10-10-20 dB
	– Continue	20 dB	20 dB

Forme d'onde sinusoidale	PM 5141	PM 5142
Tolérance d'atténuation		
– Bouton-poussior	0,2 dB	0,2 dB
– Continue	± 2 dB	± 2 db
Variation d'amplitude		
Variation maximale en fonction de la fréquence (sortie 600 Ω/amplitude max.)		
0,01 Hz ⩽ f < 10 kHz	0,5 %	0,5 %
10 kHz ⩽ f < 100 kHz	1,0 %	1,0 %
100 kHz ⩽ f < 1 MHz	–	2,0 %
Protection	Contre les courts-circuits	Contre les courts-circuits

1.2.3. Les deux versions disposent d'une lampe d'avertissement en cas de dépassement de gamme.

1.2.4. Les dimensions suivantes sont valables pour les deux versions. (montage en rack ½)

Hauteur 100 mm

Largeur 216 mm

Profondeur 355 mm

Le poids est également le même, à savoir 3,2 kg.

1.2.5. En option

Commande à distance pour toutes les gammes et fréquences des deux versions.

1.3. ACCESSOIRES

Les synthétiseurs PM 5141 et PM 5142 sont livrés avec les accessoires suivants:

– un sachet contenant deux fusibles, 180 mAT* (230 V) et 310 mAT* (115 V)
– un cordon secteur
– une notice d'emploi et d'entretien

Accessoires en option:

– Unité de programmation BCD (décimal codé en binaire) PM 9689/01; il s'agit d'une platine imprimée pouvant être montée dans les synthétiseurs et permettant la programmation à distance des fréquences provenant de contacts de commutateur, de sources logique de calculateurs, etc.

1.4. DESCRIPTION DU SCHEMA SYNOPTIQUE

Les circuits de synthétiseur comportant 4 sections principales (voir schéma Fig. 1). Ces sections sont:

1. Un générateur de fréquence comprenant un oscillateur à quartz stable 18 MHz suivi par deux diviseurs de fréquence, l'un pour obtenir la fréquence affichée et l'autre pour permettre la sélection par bouton-poussoir de la gamme de fréquence.
2. Un circuit d'élaboration numérique du signal sinusoïdal.
   Dans ce circuit un générateur élabore un programme pour dériver la fonction temps/amplitude nécessaire à l'alimentation d'un convertisseur digital-analogique.
3. Un circuit analogique de sortie pour signal sinusoïdal.
   Il comporte un convertisseur numérique analogique, dont le signal de sortie est amplifié et appliqué à un filtre passe-bas, et pour ensuite être conduit à la sortie sinusoïdale par l'intermédiaire de l'atténuateur.
4. Un circuit analogique de sortie pour signal rectangulaire, lequel comprend un amplificateur.
   Le PM 5142 comporte un circuit de générateur de fréquence analogique supplémentaire, lequel est requis pour la gamme 100 kHz à 1 MHz.

* Action differée

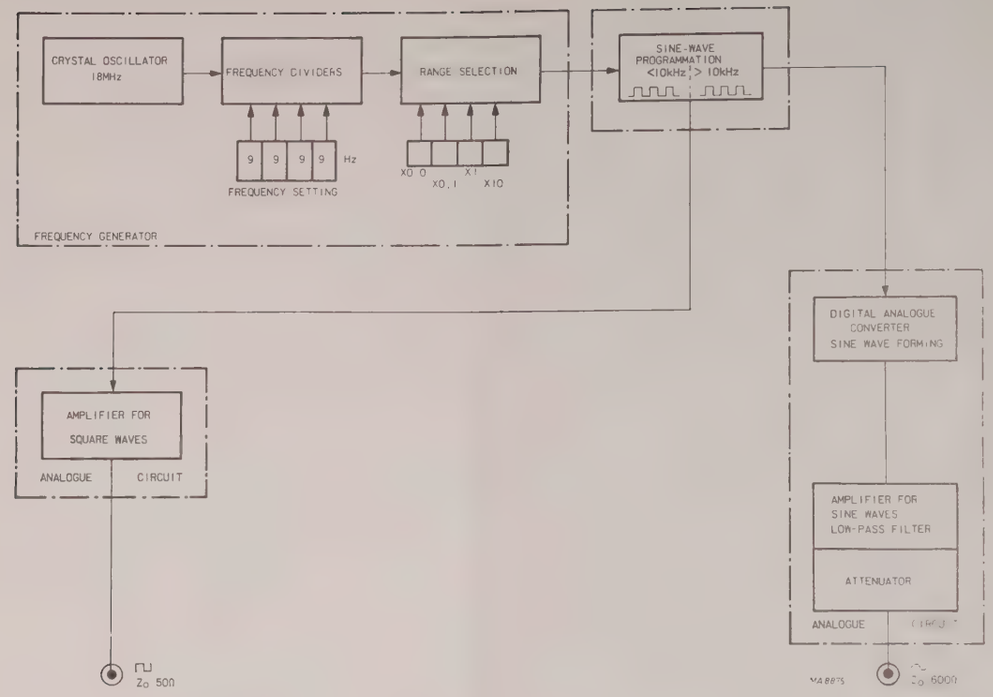


Fig. 1a. Schéma synoptique PM 5141

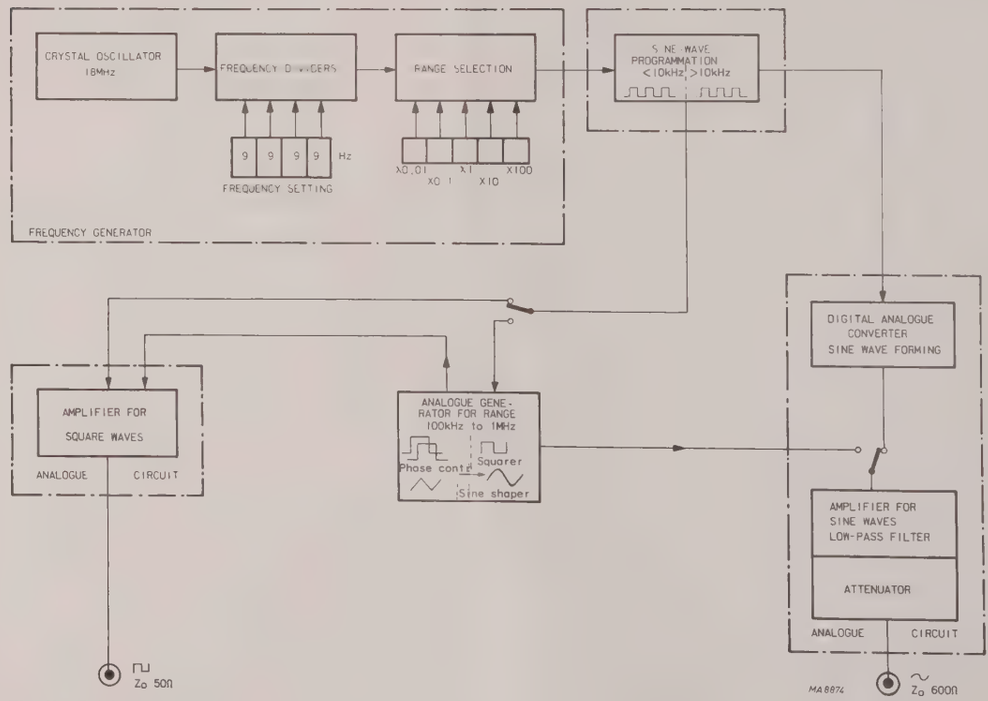


Fig. 1b. Schéma synoptique PM 5142

2. Mode d'emploi

2.1. INSTALLATION

Avant de procéder à toute autre connexion, la borne de terre de l'appareil doit être reliée à ligne de terre du réseau (voir mise à la terre),

2.1.1. Règles de sécurité (voir CIE 348 ou VDE 0411)

Avant de brancher l'appareil au secteur, vérifier si le coffret, les commandes et les connecteurs etc. ont subi quelque dommage en cours de transport. Au cas où des défauts apparents sont observé, ne pas connecter l'appareil au secteur.
Toujours débrancher l'appareil avant de l'ouvrir. Les travaux de maintenance et d'entretien à effectuer avec l'appareil enclenché doivent l'être par un technicien qualifié.
La fiche secteur ne peut être branchée que sur une prise avec terre. Ne jamais éliminer cette protection, par example à l'aide d'un câble prolongateur sans conducteur de terre.

2.1.2. Position

L'appareil doit être utilisé en position horizontale ou inclinée en faisant pivoter l'étrier-support. S'assurer que les trous de ventilation dans les plaques supérieures et inférieures sont libres.
Veiller à ce que l'appareil ne soit pas placé sur des objets produisant ou rayonnant de la chaleur.

NOTA : une zone de résistance est normale dans la première partie du mouvement de déploiement ou de reploiement.

2.1.3. Mise à la terre

Avant toute mise sous tension, l'appareil doit être connecté à la terre par le cordon secteur à trois conducteurs. La fiche secteur ne doit être introduite que dans une prise possédant un contact de terre. La mise à la terre ne doit pas être éliminée par l'emploi d'un cable prolongateur sans conducteur de terre (voir aussi Chapitre 2.1.1.). (Règles de sécurité).

ATTENTION:

Toute interruption de la ligne de terre, à l'intérieur ou à l'extérieur de l'appareil ou le débranchement de la borne de terre peuvent rendre l'appareil dangereux. L'interruption intentionnelle est formellement interdite.

Lorsqu'un appareil passe d'un endroit froid à un endroit chaud, la condensation peut provoquer un certain risque. En conséquence, il faut appliquer strictement les prescriptions de mise à la terre.
La borne terre (⊥) à l'arrière de l'appareil ne doit en aucun cas être utilisée pour connecter une terre de protection. Le potentiel de terre du coffret est connecté à la terre de protection.
Le potentiel de terre du circuit est flottante!

2.1.4. Branchement au secteur

Avant de brancher la fiche secteur, s'assurer que l'appareil est réglé sur la tension secteur locale. L'appareil ne peut être branché que sur une alimentation en alternatif. A la livraison, l'appareil est réglé sur 220 V ± 10%.
Au cas où l'appareil doit être alimenté par 127 V, procéder comme suit:

- ôter la vis maintenant la plaquette de verrouillage du sélecteur de tension situé en face arrière
- placer l'inverseur en face du repère correspondant
- remonter la plaquette de verrouillage
- vérifier la valeur du fusible : 310 mA

Une adaptation à des réseaux 117 V ou 240 V est possible, par modification de câblage à l'intérieur de l'appareil.

- déposer le couvercle de l'appareil maintenu par deux vis à l'arrière de l'appareil
- le transformateur d'alimentation est alors accessible
- le branchement du transformateur est donné par la figure suivante:

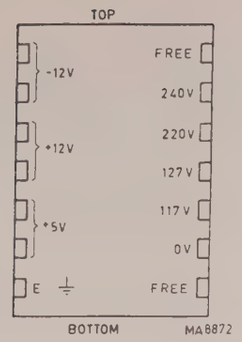


Fig. 2. Connexions de transformateur

2.2. COMMANDES ET DOUILLES

2.2.1. Panneau avant (voir fig. 3)

Identification	*Fonction*
POWER ON	Interrupteur secteur; enclenché en position superieure
⊓⊔ /Z_o 50 Ω	Sortie rectangulaire au niveau TTL; 5 V_{cc} Fixe, à 50 Ω
FREQUENCY Hz	Sélection de fréquence — quatre roues codées — résolution des roues: —4 gammes pour PM 5141 — 5 gammes pour PM 5142
x0.01	0,01 Hz à 99,99 Hz
x0.1	0,1 Hz à 999,9 Hz
x1	1 Hz à 9999 Hz
x10	10 kHz à 99,99 kHz
x100 (PM 5142 seulement)	100 kHz à 999,9 kHz
SELECT LOWER RANGE	Lampe d'avertissement rouge en cas de résolution incorrecte (c-à-d position 0 pour roue gauche en gamme x10 et x100)
~ /Z_o 600 Ω	Sortie sinusoïdale; 5 V_{cc} variable, sur 600 Ω
AMPLITUDE	Potentiomètre: l'arrêt gauche donne une atténuation de 20 dB
10 V_{pp} max.	Tension maximale en circuit ouvert: 10 V_{cc} sinusoïdal
ATTENUATION dB	Atténuation de sortie sinusoïdale par 3 plots fixes de 10 dB, 10 dB et 20 dB. L'attenuation maximale possible est: 10+10+20 dB (plots) + 20 dB (continu), c-à-d 60 dB total.

2.2.2. Panneau arrière (voir fig. 4)

Identification	*Fonction*
⊥	Borne de raccordement pour potentiel du coffret. **Attention:** il **ne s'agit pas** d'un point de raccordement pour terre de protection
310 mAT/180 mAT	Protection de surcharge par fusible 117 V ou 127 V alternatif : 310 mAT (action différée) 220 V ou 240 V alternatif : 180 mAT (action différée)
230/115	Sélecteur de tension secteur
REMOTE CONTROL	Ouverture pour fiche 24 pôles du PM 9689/01. PM 9689/01 est un accessoire en option qui permet de sélectionner la fréquence de sortie.

Fig. 3. Vue avant

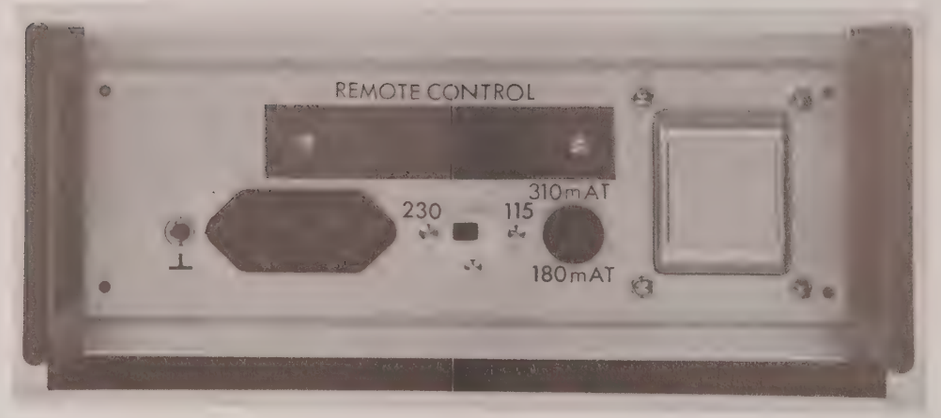


Fig. 4. Vue arrière

2.3. FONCTIONNEMENT

– S'assurer que l'appareil est branché au secteur conformément à la section 2.1.

– Enclencher l'appareil en mettant l'interrupteur en position POWER ON.

– Obeserver un temps de chauffage d'au moins 15 minutes de sorte que l'appareil atteint les caractéristiques mentionnées à la section 1.2.

– Connecter les sorties: . douille 5 V/50 Ω : rectangulaire
. douille 5 V/600Ω: sinusoïdale

– Ajuster la fréquence requise à l'aide des quatre roues codées et du sélecteur de gammes. Une lampe rouge (SELECT LOWER RANGE) avertit en cas de résolution incorrecte, c-à-d position 0 pour roue gauche en gammes x10 et x100.

– Régler l'atténuation requise pour le signal sinusoïdal à l'aide des boutons-poussoirs 10-10-20 dB et du potentiometre 0 à 20 dB.

Remarque: Il est possible de vérifier les caractéristiques de l'appareil en connectant un oscilloscope aux sorties de panneau avant et en actionnant chaque organe de commande.

2.3.1. Option pour programmation BCD

L'unité PM 9689/01 en option comprend une platine télécommande, une entretoise, une vis, un écrou et une rondelle. La platine imprimée peut être montée dans les générateurs de fréquence synthétisée PM 5141 et PM 5142, ce qui permet une programmation BCD télécommandée.
Les entrées externes d'une unité de programmation vers cette platine se font à l'aide d'une douille Amphenol à 24 pôles à l'arrière du générateur. Le type de programmation de fréquence (télécommandée ou locale) est choisi par un signal logique à la broche 18 de cette douille. Les broches 1 à 16 reprennent la fonction des sélecteurs de fréquence sur le panneau avant. Les brohces 1 à 4 permettent le codage binaire des Unités, les broches 5 à 8 celui des Dizaines, 9 à 12 celui des Centaines, 13 à 17 celui des Milliers (voir Fig. 5).

TABLE 1

Chiffre sélect	Broches de douille Amphenol 1	2	3	4	
					Unités
	(5)	(6)	(7)	(8)	Dizaines
	(9)	(10)	(11)	(12)	Centaines
	(13)	(14)	(15)	(16)	Milliers
	Code binaire				
0	0	0	0	0	
1	1	0	0	0	
2	0	1	0	0	
3	1	1	0	0	
4	0	0	1	0	
5	1	0	1	0	
6	0	1	1	0	
7	1	1	1	0	
8	0	0	0	1	
9	1	0	0	1	

Table de vérité pour sélection de fréquence

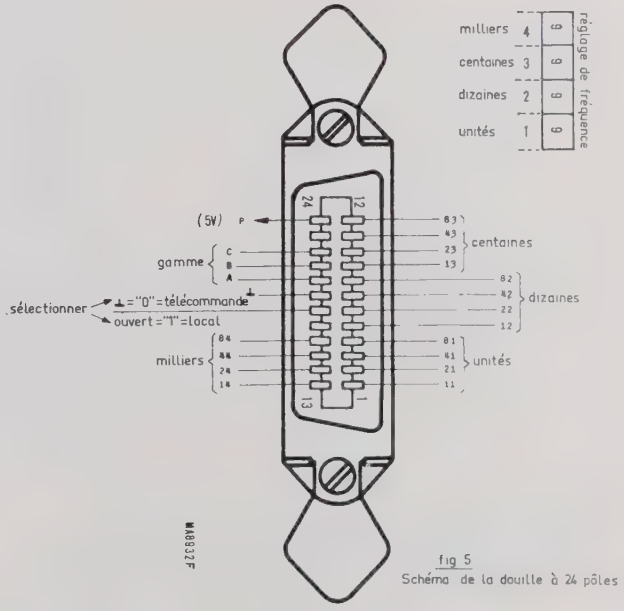


fig 5
Schéma de la douille à 24 pôles

– Programmation de fréquence: 4x4 fils logique positive
– Programmation de gamme: fils A; B; C logique positive

Fig. 5. Schéma de la douille à 24 pôles

La sélection de gamme se fait par signeaux ou points 20, 21 et 22 conformément à la table 2.

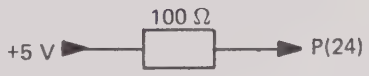
TABLE 2

Gamme	Broche 20	Broche 21	Broche 22
x0.01	0	0	0
x0.1	1	0	0
x1	0	1	0
x10	1	1	0
x100	0	0	1

Table de vérité pour sélection de gamme

TABLE 3

Entrées	Charge standard TTL (1 charge standard TTL ≙ 1,6 mA	Contacts
4x4 BCD	chaque 1	1 à 16
A	2	20
B	1	21
C	3	22
Sélectionner	5	18



La logique du signal à la broche 18 détermine le mode de sélection, programmation manuelle ou télécommande. Pour logique "haute" (Logique 1), la programmation locale est réalisée à l'aide des commandes du panneau avant. Pour logique "basse" (logique 0, interconnexion interne à la terre, broche 19), la programmation est obtenue à partir des contacts de commutateur, de sources logiques de calculateur, etc.
La programmation télécommandée peut s'obtenir simplement à l'aide du commutateurs mécaniques; une plus grande flexibilité est cependant possible si l'on utilise une matrice à diodes. Etant donné que les programmations peuvent différer, des commutatuers électroniques peuvent replacer les commutateurs mécaniques, comme par example ceux utilisés dans le systeme logique S & I sur une carte F1 (numéro de code 5322 216 24017).
Dans l'alternative, les impulsions de logique de calculateur peuvent être utilisées pour fournir les signaux d'entrée à la douille à 24 pôles. La logique de calculateur doit être positive et fournir les entrées indiquées en table 3.

Instructions de montage (voir Fig. 6.)

1. Enlever les 4 vis dans les deux butées du panneau arrière.
2. Enlever les barrettes ornementales du cabinet.
3. Déposer les plaques supérieure et de fond.
4. Déposer le couvercle (2 vis) portant l'indication REMOTE CONTROL à l'arrière de l'appareil. Conserver les vis et rondelles en lieu sûr.
5. Enlever la soudure du trou dans la platine de circuit principal (fig. 6).
6. Placer l'entretoise sur la platine de circuit principal (rondelle et écrou côté imprimé).
7. Connecter les câbles avec des fiches multipolaires conformément à la figure 6. S'assurer que les points rouge et blue des fiches correspondent aux points sur la platine de circuit principal.
   - Déposer la fiche multipolaire T,
   - Déposer la fiche multipolaire S du connecteur P' et l'enficher sur le connecteur S' sur la platine de commande à distance.
   - Enficher les fiches multipolaires des câbles P, Q, R sur la platine de commande à distance sur les connecteurs P', Q' et R' de la platine de circuit principal.
8. Monter la platine avec douille à 24 pôles sur le panneau arrière à l'aide des vis et rondelles enlevées (voir point 4) La partie composants doit faire face à l'appareil.
9. Visser la platine de commande à distance sur l'entretoise.
10. Fermer l'appareil conformément aux points 3, 2 et 1 successivement.

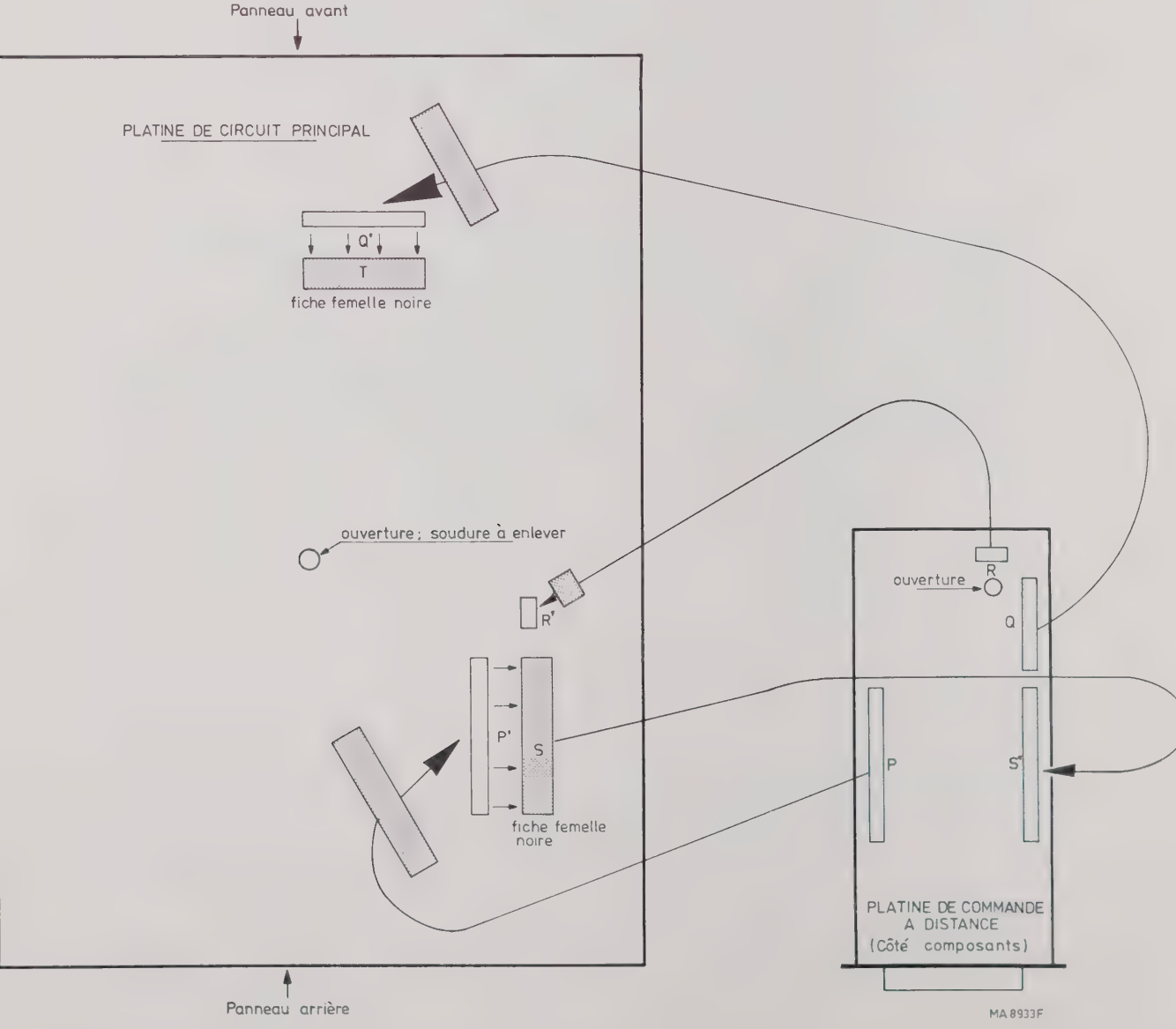


Fig. 6. Connexions requises

Service data

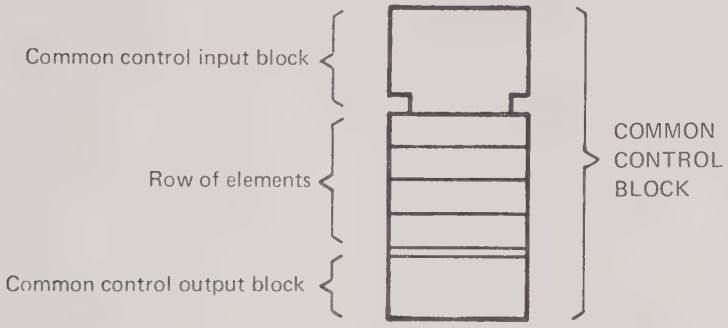
3. Service Data

3.1. CIRCUIT DESCRIPTION

3.1.1. **Introduction to drawing symbols** for binary logic medium scale integrated circuits

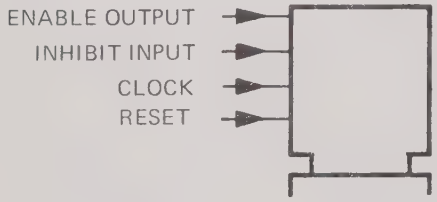
3.1.1.1. Common control block

The use of medium scale integrated circuits (M.S.I.'s) necessitated an abbreviated notation for the interdepency of various functions, as well as simplified symbols for complex functions.
The most important information is: which signals appear at the input and how the outputs behave with respect to the function of the IC.
To give a short indication of the function and the relation between the different elements of the IC, the International Electronical Commission (IEC) proposed a so-called "COMMON CONTROL BLOCK".
A common control block is a symbol for a complex circuit, composed of 3 parts:
a common control input block, a row of elements and a common control output block.



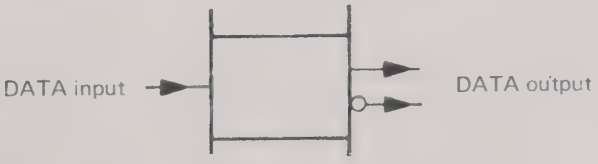
3.1.1.2. Common control input block

On the common control input block, all **common** input lines are connected. These lines must have functional relation to the other elements of the common control block. Examples: general reset, enable output, inhibit input, clock signal etc.



3.1.1.3. Row of elements

Each element of the row has its own in- and outputs. Example: it can be a D-flip-flop with one data input and two outputs (one inverted and the other not inverted).



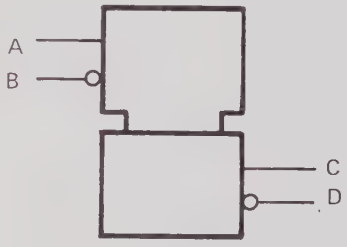
3.1.1.4. Common control output block

On the common control output block the common or resulting outputs of the elements are drawn. Example: it can be a carry or a borrow signal for a counter.

3.1.2. Input and output lines

Input lines are drawn at the left side of a common control block, output lines at the right side.

In- and output lines on common control blocks can be drawn with and without circles, as shown in fig.5.

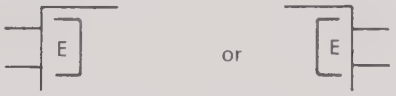


Meaning of the above-drawn lines A, B, C and D:

- Line A is active for the block when it is high (''1'') and inactive when it is low (''0'').
- Line B is active for the block when it is low (''0'') and inactive when it is high (''1'').
- Line C is low (''0'') in the rest state of the element or when output is inhibited. This output is then inactive.
- Line D is high (''1'') in the rest state of the element or when output is inhibited. This output is then inactive.
- When line C is ''high'', this output is active.
- When line D is ''low'', this output is active.

3.1.3. List of characters and symbols

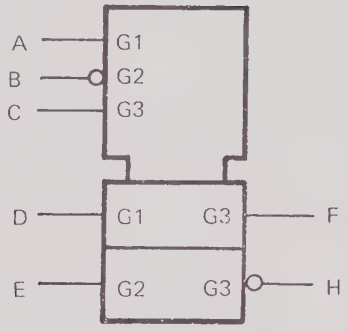
In the common control blocks, characters and symbols are used to indicate the function of the in- and outputs.

Character	*Name*	*Description*
A	address or data bit	Most of the time, the A is used for an address of a memory location. In arithmetic elements (adders) the A is used for data bits.
B	data-bit	Data bit in arithmetic elements (adders)
C	command input (clock)	Trigger input for counters, shift registers D and JK flip-flops etc.
C_n	carry	Carry input signal for adders
C_{n+1}	carry	Carry output signal by adders
CT	counter state	Used, together with a numeral, for marking the state of a counter. Example: CT = 9 means "counter in state 9"
D	preparatory input	D-input for D type flip-flops
E	expander	Expandable in- and outputs; in the blocks marked as follows:  input output
G	command input (enable)	Input which enables related in- and outputs to be active.
J	preparatory input	J input of JK type flip-flop.
K	preparatory input	K input of JK type flip-flop
M	matrix address	Matrix address as used in rate multipliers.
P	forcing input (preset)	Input which sets related outputs to a fixed state.
R	forcing input (reset)	Input which sets related outputs to an inactive state.
RA	read address	Address for a memory location, used for reading.
S	forcing input	Input which sets related outputs to an active state.
WA	write address	Address for a memory location, used for writing.
Σ	sum	Sum output for adders.
+1	count up	Count up command, used in counters.
−1	count down	Count down command, used in counters.
←	shift left	Shift left command, used in shift registers.
→	shift right	Shift right command, used in shift registers. Note: it is also used in decoders for marking the type of decoding. BIN ⟶ DEC means for example a "binary to decimal decoding".
⌐	negative box corner	Used by outputs to indicate that its state can change only on the negative edge of the relevant trigger input.
⌐	positive box corner	Used by outputs to indicate that its state can change only on the positive edge of the relevant trigger input.
00	even parity	Even parity in a parity checker
000	odd parity	Odd parity in a parity checker
-X-	no information	Line carrying no logic information.

3.1.4. Use of some characters and symbols

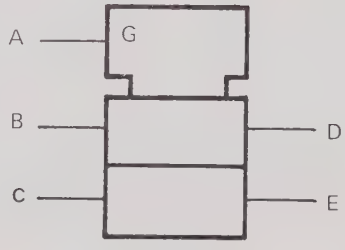
3.1.4.1. Enabling and inhibiting

Example 1



– Line A active ("1"):
  input is enabled for line D
– Line A inactive ("0"):
  input is inhibited for line D
– Line B active ("0"):
  input is enabled for line E
– Line B inactive ("1"):
  input is inhibited for line E
– Line C active ("1"):
  output is enabled for lines F and H.
– Line C inactive ("0"):
  output is inhibited for lines F and H.

Example 2:

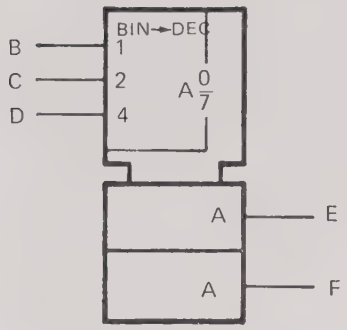


– Line A active ("1"):
  input is enabled for lines B and C
  output is enabled for lines D and E
– Line A inactive ("0"):
  input is inhibited for lines B and C
  output is inhibited for lines D and E

What means: if an enable line is valid for all in- and output lines on all elements and the output block, the G is omitted in the elements and in the output block.

3.1.4.2. Addressing

Example:



In the common control input block, the lines B, C and D are applied to a converter, which translates the binary code (1-2-4) in a decimal code.

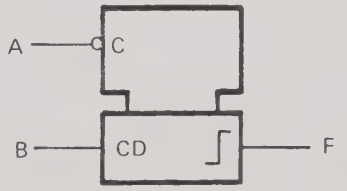
$\frac{0}{7}$ means that eight different codes can be decoded.

A $\frac{0}{7}$ means that these eight codes are used for eight different memory addresses.

In the row of elements, the A indicates that lines E and F show the contents of a memory location, selected with the memory address in the common control input block.

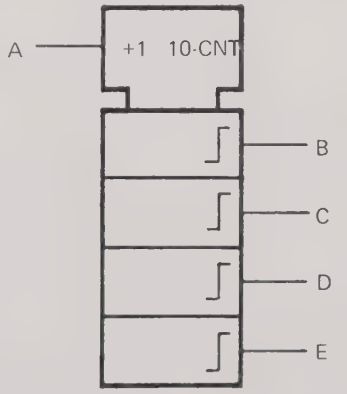
3.1.4.3. Triggering

Example 1:



- Line A is the trigger input line (C).
- Line B is the data-input line. Data can enter only by CD, which means that: when the clock C is active ("0"), a "0" or a "1" (= D-input) can enter.
- Line F is the data-output line. The boxcorner indicates that the stored data is available on this output line on the positive-going edge of the trigger pulse on line A

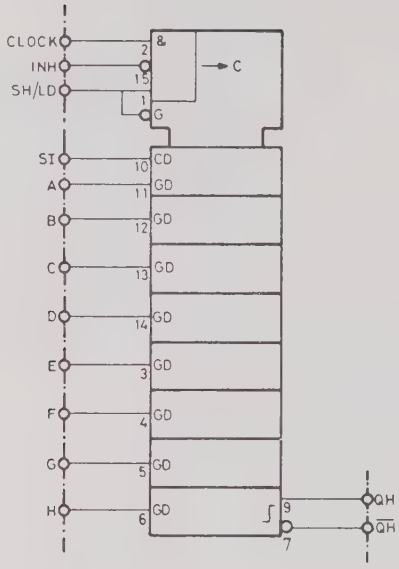
Example 2:



This counter makes its steps, as shown by the boxcorners, on every positive going edge of the trigger input line (+1).

3.1.4.4. Explanation of some examples

example 1



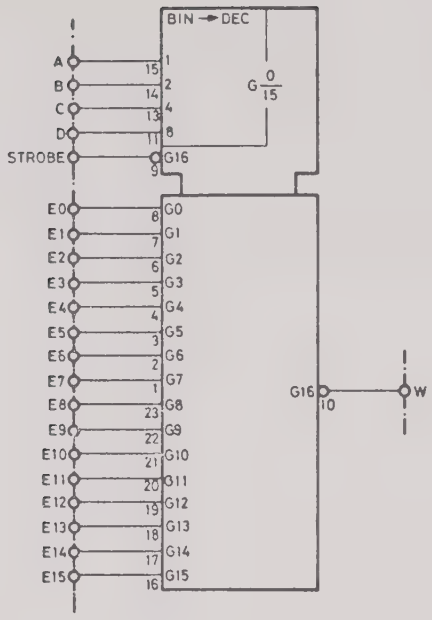
E10 | 8 BIT SHIFT REGISTER

-- it is a shift register. (⟶ in common control input block).
– 8 bits (8 elements are drawn).
– all elements are D flip-flops (D at input)
– shifting (⟶) depends on being true of an and-gate. This means that:
"Clock" must be "1" and
"INH" must be "0" and
SH/LD must be "1".
– the output changes on the positive-going edge of the shift trigger pulses (⌐¯).
– parallel load into all eight elements is only possible when SH/LD is "0" (G must be active).
– serial load into the first element takes place during the trigger pulse C, independent of G.
– a logic "1", stored or shifted into the last element, is active at the output as follows:

QH = 1

$\overline{QH}$ = 0.

example 2



I4 | MULTIPLEXER

– "BIN ⟶ DEC" in the **input block** indicates that the four input lines A, B, C and D, entering in the 1-2-4-8 code as marked, are decoded to decimal numbers.
– G $\frac{0}{15}$ indicates that the decoded decimal numbers are: G0 or G1 or G2 etc. to G15.
– in the **element**, G0 to G15 are used as enable signals for the input lines E0 to E15
– since only one of the decimal numbers G0 to G15 can be active, only one selected input signal can enter the element.
– this input signal appears at the output depending on G16. When G16 is active (STROBE = "0"), the input signal appears at the output, but inverted as marked with the output circle.
("1" at the input ⟶ "0" at the output or "0" at the input ⟶ "1" at the output).
– when G16 is inactive (STROBE = "1"), the output is inactive (W = "1").

3.1.5. Frequency Determination (see Fig. 7).

The square-wave output of a reference oscillator is divided to allow the numerical selection of the desired frequency by a combination of thumbwheel switches and range selection pushbuttons.

Basically, the circuit consists of:
- a crystal-controlled, emitter coupled Buttler oscillator followed by an amplitude-limiting stage to produce an 18 MHz square-wave output for the inputs of the digital circuits.
- a frequency divider, for numerical selection, controlled by the four front-panel thumbwheel switches. Each of the four switches controls a divider by 0 to 9, which in cascade form a divider of $10^4 - 1$.

- a range selection frequency divider controlled by the front-panel pushbutton switches (four ranges for the PM 5141, five ranges for the PM 5142).

TYPES	RANGES				
	x0.01	x0.1	x1	x10	x100
PM 5141	0.01 Hz to 99.99 Hz	0.1 Hz to 999.9 Hz	1 Hz to 9999 Hz	10 kHz to 99.99 kHz	–
PM 5142	0.01 Hz to 99.99 Hz	0.1 Hz to 999.9 Hz	1 Hz to 9999 Hz	10 kHz to 99.99 kHz	100 kHz to 999.9 kHz

This divider consists of two counters which, depending on the range selected, basically divide by 1, 10 or 100. A divider by 3/2 is included for the 10 kHz - 100 kHz range. A divider by 3 passes the selected frequency to programming circuits for producing the square-wave or sine-wave outputs.

3.1.5.1. Method of frequency selection

Each thumbwheel switch controls a divider by 0 to 9.
As these are in cascade, if N is the value of the front-panel number set between 0001 and 9999, the circuit requirement is that the register output D3OUT must be high during N/10,000 of the time.

Each thumbwheel can select a value from 0 to 9, the thumbwheels from left to right being represented by N1, N2, N3 and N4 respectively.
- The first (left-hand) thumbwheel switch selects N1 tenths of the oscillator frequency (i.e. 0 to 9 tenths).
- The second thumbwheel switch selects N2 hundredths of the oscillator frequency.
- The third thumbwheel switch select N3 thousandths of the oscillator frequency.
- The fourth thumbwheel switch selects N4 ten-thousandths of the oscillator frequency.

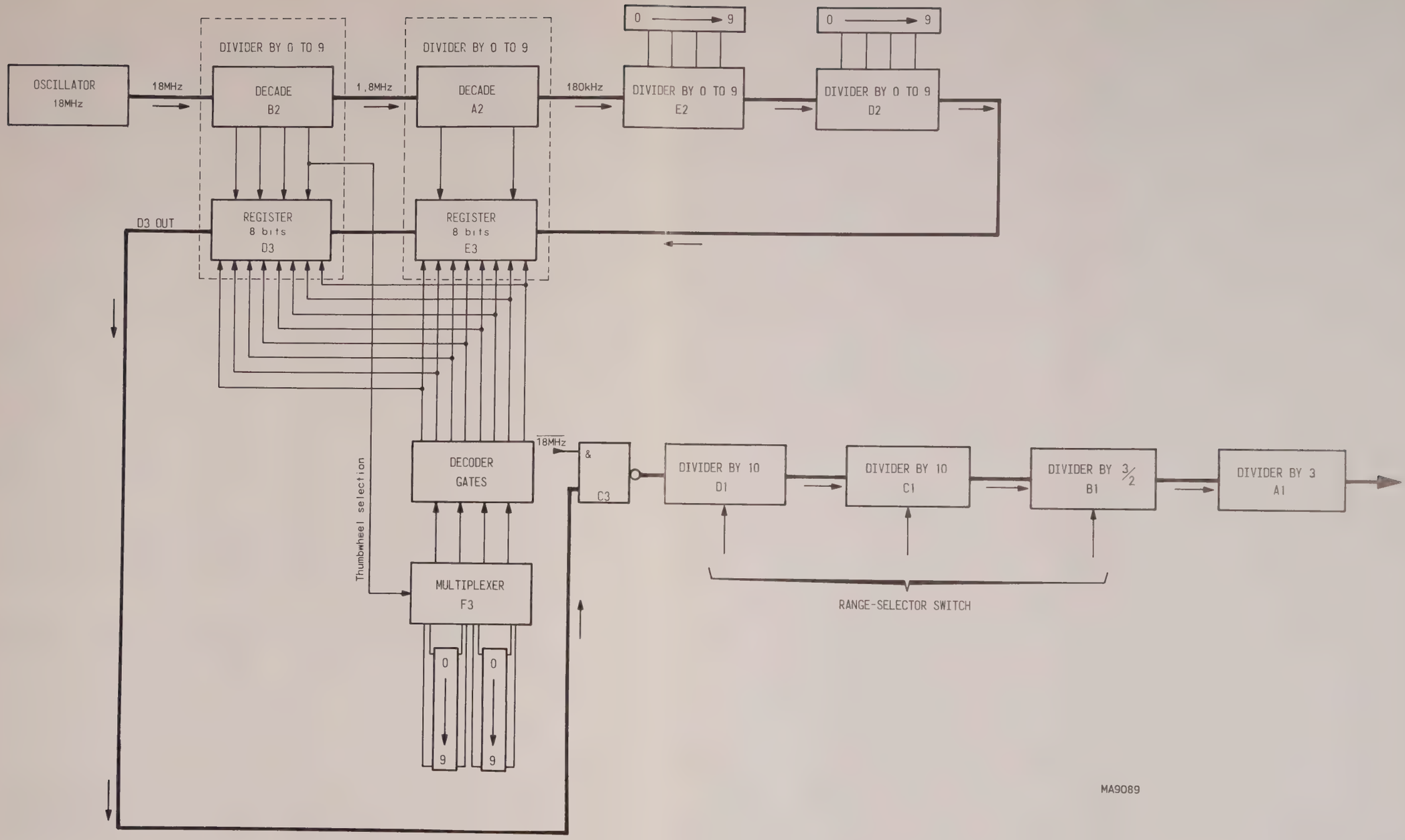
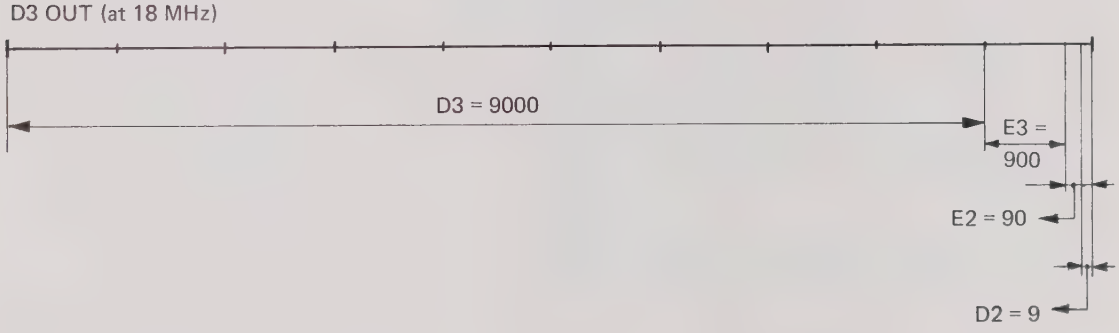


Fig. 7. Block diagram of freq. generator part

Tabel I

Thumbwheel switches	Divider by 0 to 9	10,000ths of 18 MHz
Thousands (N1)	B2 + D3	9,000
Hundreds (N2)	A2 + E3	900
Tens (N3)	E2	90
Units (N4)	D2	9

The time for which D3OUT is high is dependent on the setting of the thumbwheel switches.
For example, a setting of 9999 would mean that D3OUT is high for $^{9999}/_{10,000}$ of the time.
A setting of 0009 would mean that D3OUT is high for $^{0009}/_{10,000}$ of the time, i.e. only during the time allocated to the counter D2.



The various times are added to obtain a maximum of $^{9999}/_{10,000}$ of the crystal controlled oscillator frequency 18 MHz). In this way, the number selected on the thjmbwheel switches produces a logic high signal for N/10,000 of 18 MHz at the output of the frequency (D3OUT).
The high output at D3OUT gates the oscillator frequency applied to input 9 of gate C3.
To add these times, the selected information in the second register, E3, gives a high during the remaining 1/10th of the time not allocated to the first register, D3. Register D3 never gives a high level in position 6 of B2. The necessary pulse to obtain maximum division of $\frac{9999}{10.000}$ x 18 MHz is supplied by the other dividers.

Dividers A2 and B2 (Fig. 8 and 9)

Dividers B2 and A2 are 4 bit-decade counters connected in cascade.
Basically, they divide the 18 MHz oscillator frequency by a hundred to produce 180 kHz at the A2CAR output for subsequent dividers E2 and D2. Additionally, they provide the following pulses for wave-shaping:

B2 counter	A2 counter
B2B1	A2B1
B2B2	A2B8
B2B4	
B2B8	

Output B2CAR cannot be used directly as a control signal for input 7 (enable P) of the second counter A2 as it is too much delayed with respect to the 18 MHz oscillator. Therefore, the oscillator frequency (18 MHz), enabled by B2B1 information is applied to its input 7 (enable P). Counter A2 only counts during high position of B2B8; then and only then A2 counts one step further.

Dividers E2 and D2 (Table II)

Subsequent division of the oscillator frequency by 1,000 and 10,000 is effected by two synchronous decade rate multipliers E2 and D2.
The outputs 5(E2) and 6(D2) produce a number of logic pulses dependent on digits 1 to 9 selected by the tens and units thumbwheel switches. When 0s are selected output 5 of E2 is permanently high and output 6 of D2 is permanently low; consequently, no serial pulses are fed to register E3.

Table II

L=LOW H=HIGH			INPUTS						OUTPUTS LOGIC LEVEL OR NUMBER OF PULSES		
CLEAR (13)	ENABLE (11)	STROBE (10)	D (3)	C (2)	B (15)	A (14)	NUMBER OF PULSES	UNITY/ CASCADE (12)	Y (8)	Z (5)	ENABLE (7)
L	L	L	L	L	L	L	10	H	L	H	1
L	L	L	L	L	L	H	10	H	1	1	1
L	L	L	L	L	H	L	10	H	2	2	1
L	L	L	L	L	H	H	10	H	3	3	1
L	L	L	L	H	L	L	10	H	4	4	1
L	L	L	L	H	L	H	10	H	5	5	1
L	L	L	L	H	H	L	10	H	6	6	1
L	L	L	L	H	H	H	10	H	7	7	1
L	L	L	H	L	L	L	10	H	8	8	1
L	L	L	H	L	L	H	10	H	9	9	1

MA9177

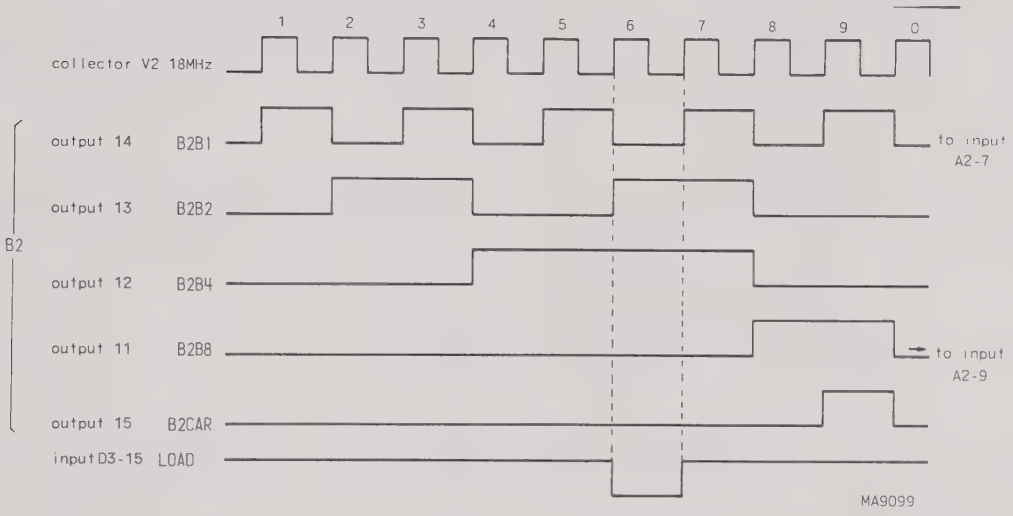


Fig. 8. Counter B2 pulses

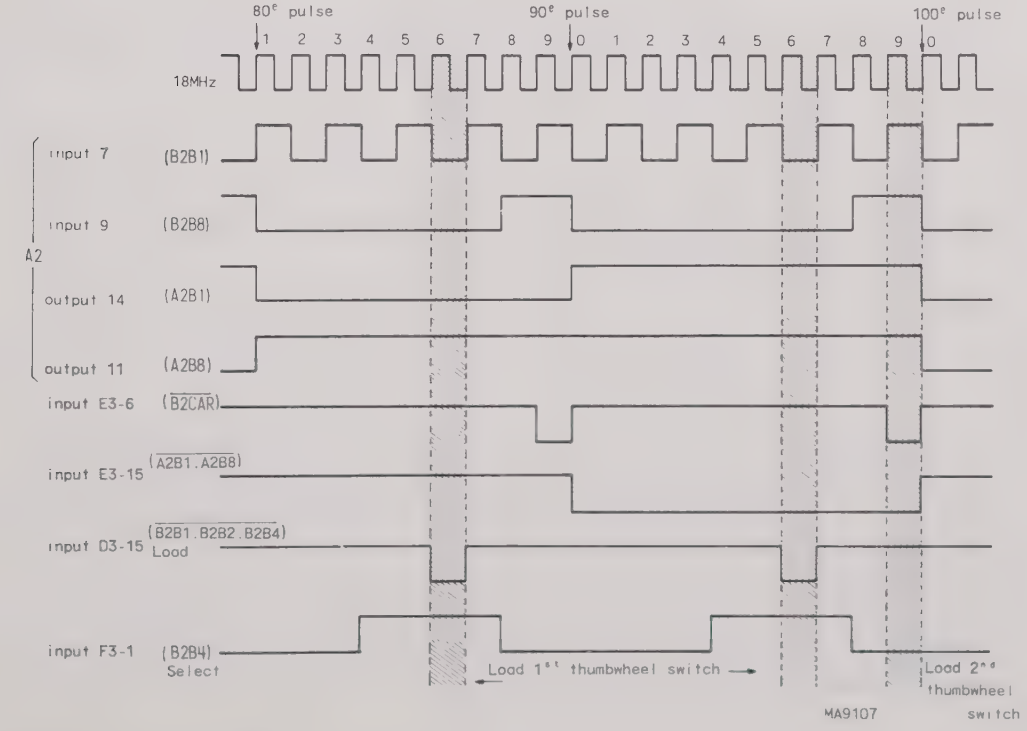


Fig. 9. Counter A2 pulses

The outputs determined by the setting of the thumbwheel switches are:

$$f_{output} = \frac{N \cdot f_{input}}{10}$$

where N is the digital number selected. The thumbwheel switches select the number by a four-digit binary code in accordance with the truth table shown in the circuit diagram Fig. 29.

If both thumbwheels are set to decimal position 9, output 5 (E2) and enable output 7 (E2) are both low for each high A2CAR pulse on pin 9. This also applies for outputs 5 and 7 on D2 but these are not used. All pulses from dividers E2 and D2 then produce high level outputs during the A2CAR pulse, i.e. for $\frac{9999}{10.000}$ of the oscillator time.
This series information is passed to input 1 (E3) via input 10 of A3 when A2B1 (input 9 of A3) is high. This is almost the same as setting the series input of E3 to '1' (100/10,000 of the oscillator time) by means of the second thumbwheel switch which employs A2B1 (input 9 of C2).

Multiplexer F3 and decoder gates

The outputs of the first two thumbwheel switches, thousands and hundreds, set the inputs of multiplexer F3. Alternate selection of the two thumbwheels is obtained by the two states of B2B4 applied to control inputs G1, G2.

State of B2B4	Thumbwheel selected
1 (G2 enabled)	1,000's
0 (G1 enabled)	100's

The logic outputs of the multiplexer control an assembly of decoder gates, D4, E4, F4, B4 and C2, which in turn, control the parallel information feed to shift registers D3 and E3.

8-bit shift registers D3 and E3

Register D3 is controlled by the first thumbwheel (thousands) and E3 by the second thumbwheel (hundreds). Selection of hundreds or thousands information is performed by pulses B2B4 as described in the previous paragraph.
The principle of operation of these registers is identical except for the loading. Loading of D3 (pin 15) via output 12 of NAND gate B3, is effected during B2B4 (position 6 of B2) when B2B1 is low and B2B2 is high. Loading of E3 (pin 15) via output 11 of NAND gate A3 occurs when A2B1 and A2B8 are high and B2CAR gives a low output on pin 6 of inverter gate C2.
When the output of register E3 (E3OUT) is '1', the series input (1) of the first register D3 is set to '1' during B2B8 so that a '1' is produced at the output during position 6 of the B2 counter, a position which corresponds to the free space from the first thumbwheel switch logic.

Considering the first thumbwheel, its operation is best understood by assuming it is set to any decimal number from 0 to 9, the other switches being at zero.

Parallel inputs of D3

Parallel inputs 2, 3, 4, 5, 10, 11, 12, 14 (A to H respectively) of register D3 assume states fixed by multiplexer F3 and the decoder gates in accordance with the position of the first thumbwheel switch as shown in table III.

As soon as the load pulse is present (position 6 of B2 as described previously), the state of the parallel inputs is introduced into the D3 register. As the loading is synchronous, the information available at input 14 (H), the last flip-flop of D3, is present at the output in position 7 of counter B2, i.e. the first after the load position. The diagram (Fig. 10) indicated in each column the logic state of the flip-flops A to H dependent on the read-out of the first thumbwheel switch.

The shift register D3 gives the same number of logic '1's at output 13 as selected on the first thumbwheel switch. For example, digit 4 selected on the switch results in 4 logic '1' pulses at output 13 (D3OUT).
As D3 is an 8-bit register, it is necessary to code the information at input 1 (series) during two of the pulses following the loading to obtain the correct level at the output for the decimal coding.

Table III

DECIMAL VALUE	STATE OF OUTPUTS OF F3				STATE OF THE INPUTS OF D3 OR E3 (AS A FUNCTION OF THE STATE OF INPUT 1 OF F3)							
	4	7	9	12	2 A	3 B	4 C	5 D	10 E	11 F	12 G	14 H
0	1	1	1	1	0	0	0	0	0	0	0	0
1	0	1	1	1	0	0	0	1	0	0	0	0
2	1	0	1	1	0	1	0	0	0	1	0	0
3	0	0	1	1	1	0	0	1	0	0	1	0
4	1	1	0	1	0	0	1	0	1	0	0	1
5	0	1	0	1	0	1	0	1	0	1	0	1
6	1	0	0	1	0	1	1	0	1	1	0	1
7	0	0	0	1	1	0	1	1	1	0	1	1
8	1	1	1	0	1	1	1	0	1	1	1	1
9	0	1	1	0	1	1	1	1	1	1	1	1

MA9176

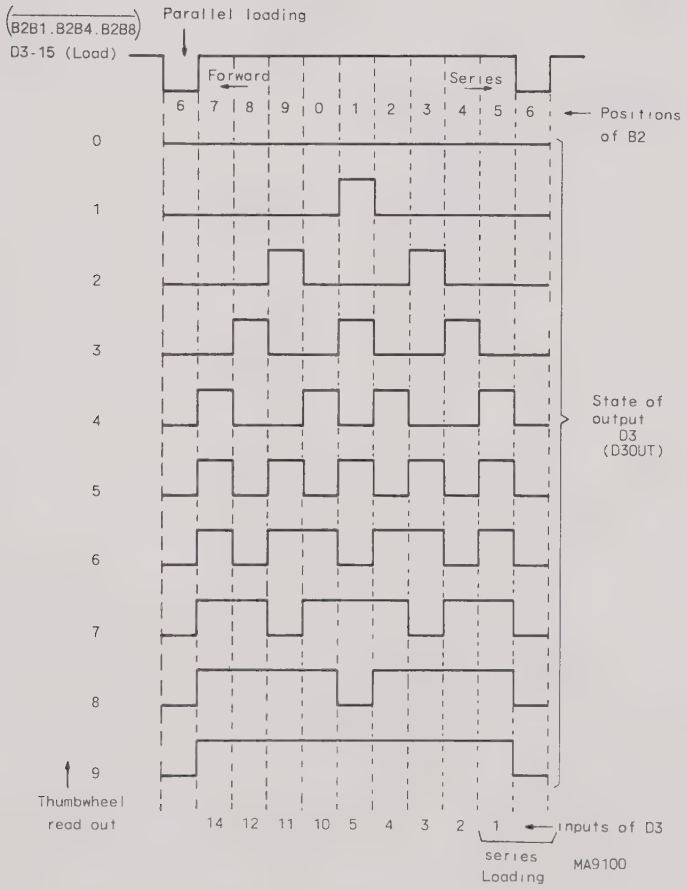


Fig. 10. Register D3 pulses

Table IV

No. selected on thumbwheel	Multiplexer E3 outputs				8-bit Register D3	8-bit Register E3	Divider E2		Divider D2			Results
	F3Q1	F3Q2	F3Q3	F3Q4				output pin	input pin		output pin	
0000	1	1	1	1	0 parallel info	0 parallel info	$\frac{18\text{ kHz}}{10} \times 180\text{ kHz} = 0$	7 5	10 12	$\frac{18\text{ kHz}}{10} \times 18\text{ kHz} = 0$	6	No output
0009	1	1	1	1	0 parallel info	0 parallel info	$\frac{18\text{ kHz}}{10} \times 180\text{ kHz} = 0$	7 5	10 12	$\frac{18\text{ kHz}}{10} \times 18\text{ kHz}$ shaped by 0	6	0009 shifts serially via E3 and D3 to range select. switches
0099	1	1	1	1	0 parallel info	0 parallel info	$\frac{18\text{ kHz}}{10} \times 180\text{ kHz} = 162\text{ kHz}$	7 5	10 12	$\frac{18\text{ kHz}}{10} \times 18\text{ kHz}$ shaped by 162 kHz	6	0099 shifts serially via E3 and D3 to range select. switches
3(9)99	0 (0	0 1	1 1	1 0)	Three logic '1's parallel info	Nine logic '1's series and parallel info	"			"		Series and parallel info shifted through E3 and D3 to range select switches
3(9)99	0 (0	1 1	1 1	0 0)	Nine logic '1's series and parallel info	"	"			"		"

Series inputs of D3

Here, two cases must be considered; decimal numbers 0 to 3 and decimal numbers 4 to 9 selected on the first thumbwheel. As previously explained, register D3 is loaded during decoding position 6 of counter B2.
When the decimal selected is 0 to 3, input 1 (series) of D3 must be at logic '0' during position 5 of B2 in order to give logic '0's at output 13 (D3OUT). During positions 6 and 7 of B2 D3OUT is also kept at logic '0'. Position 6 is thus freed for pulses from the hundreds, tens and units dividers.

For numbers 0 to 3, outputs F3Q3 and F3Q4 of the multiplexer are at logic '1', as well as input 4 of gate C3. As the other thumbwheel switches are assumed to be set at 0, input 5 of gate C3 is at logic '1' and therefore output 6 is at logic '0'.
When the decimal selected is 4 to 9, input (series) of D3 is at logic '1' during position 5 of B2 which results in a logic '1' at output 13 (D3OUT) during position 5 after being shifted through the eight positions of the register. The logic '1' on input 1 (series) during position 5 is available because F3Q3 and F3Q4 outputs of the multiplexer are of different logic level for decimal numbers 4 to 9 of the first thumbwheel switch. These outputs produce logic '1' at input 2 of gate C3, which together with a logic '1' on input 1 of C3 during position 7 of B2 (B2B1) gives a logic '0' on output 3 of C3. This gives the necessary logic'1' at input 1 (series) of D3.

As in the case of the lower digits, for loading, when B2B1 is at logic '0' (position 8), input 1 (series) of D3 becomes logic '0' so that after shifting through the eight positions of the register a logic '0' is available at output 13 (D3OUT) in position 6, assuming the other thumbwheels are set at 0.

Table IV summarizes the functions of the dividers for a typical selection of digits on the thumbwheel switches, before considering the method of range selection.

3.1.5.2. Range selection

The output D3OUT is now at logic '1' for a selected number of tenthousandths of the oscillator time depending on the thumbwheel setting. For a setting of 9999, for example, output 8 of gate C3 gives 9999/10,000 of the oscillator frequency applied at input 9 of C3.

The circuit for range selection consists of two decimal counters D1 and C1 and a divider by 3/2, B1, used only in the 10 kHz - 100 kHz range and 100 kHz - 1 MHz range for the PM 5142 (x10 and x100 pushbuttons respectively). Counters C1 and D1 divide the output frequency applied to the range selection circuit by 1, 10 or 100 (x1, x0.1 and x0.01 pushbuttons respectively).

Dividers D1 and C1

Ranges	D1	C1	Result
x0.01	divides C3-8 output by 10	divides D1CAR by 10	C3-8 divided by 100
x0.1	divides C3-8 output by 10	loaded by PLQ2	C3-8 divided by 10
x1	loaded by PLQ4	loaded by PLQ2	C3-8 not divided

In these ranges, command signal PLQ12 is at logic '0' so input 2 of the 3/2 counter B1 is also at '0'. Consequently output 13 is at logic '1' and therefore output 8 of B3 is the inverted C1CAR signal (ripple clock); i.e. the 3/2 counter is not in circuit.

Divider B1 (3/2 counter)

In the x10 range, PLQ12 is at logic '1', and allows the bistables to divide under the control of the command signals from the C1CAR (ripple clock). The resulting division by 3/2 gives a ripple frequency of 12 MHz at output 8 of gate B3 for selected frequencies above 10 kHz and still assuming a setting of 9999, see Fig. 11. This provides for the principle of wave-forming used in this range (also for 100 kHz - 1 MHz, x100 range of PM 5142).

Divider A1 (3 counter)

The frequency generation assembly is terminated by a divider by 3 consisting of the two flip-flops A1 which are operative for all frequencies. This divider reduces frequency jitter caused by the unequal mark-space ratio of the pulses selected by the thumbwheel switches. As shown in Fig. 12 the output B3-8 has a deviation between two trailing edges of 1 in 2, which is reduced to a deviation of 1 in 5 at the Signal Clock (A1 output 9). This signal clock, which represents the selected frequency, is then passed to the wave-forming circuits. The signal clock has a maximum frequency of 4 MHz for ranges above 10 kHz and 6 MHz for ranges below 10 kHz.

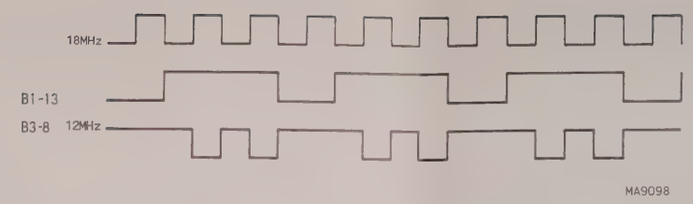


Fig. 11. Pulses from 3/2-counter

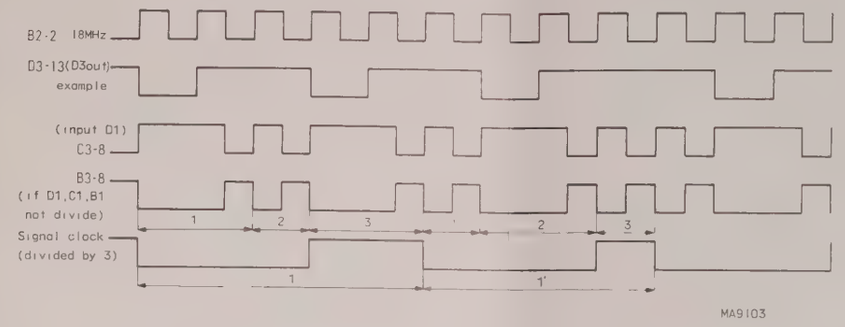


Fig. 12. Pulses from 3-counter

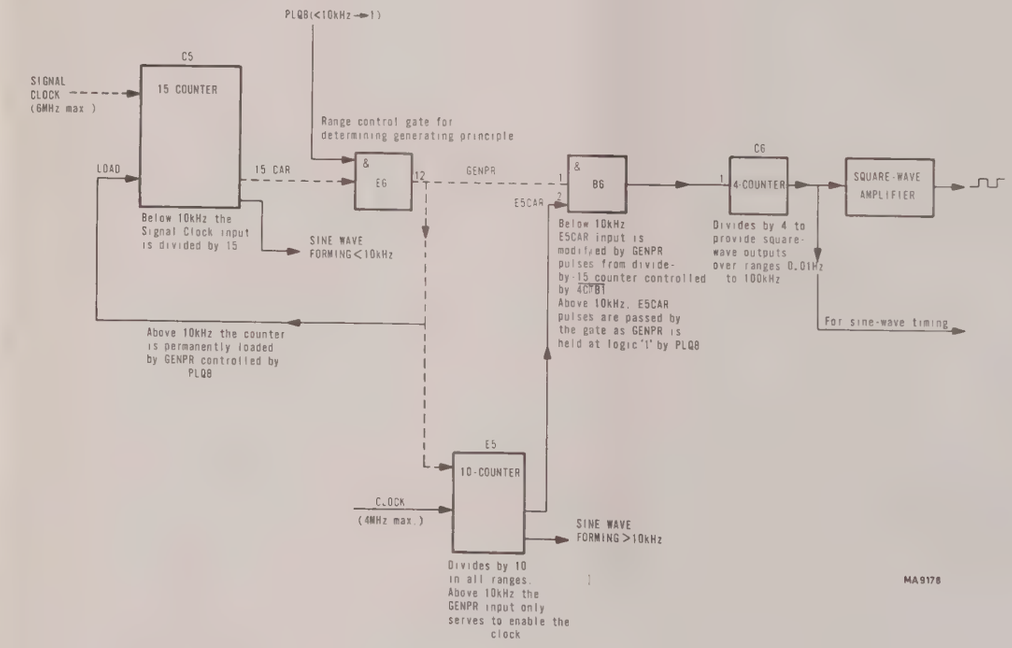

PLQ8(<10kHz→1)
C5
SIGNAL CLOCK (6MHz max.)
15 COUNTER
LOAD
15 CAR
Range control gate for determining generating principle
&
E6
12
GENPR
E5CAR
B6
C6
4-COUNTER
SQUARE-WAVE AMPLIFIER
Below 10kHz the Signal Clock input is divided by 15
SINE WAVE FORMING<10kHz
Below 10kHz E5CAR input is modified by GENPR pulses from divide-by-15 counter controlled by 4CM81
Above 10kHz, E5CAR pulses are passed by the gate as GENPR is held at logic '1' by PLQ8
Divides by 4 to provide square-wave outputs over ranges 0.01Hz to 100kHz
For sine-wave timing
Above 10kHz the counter is permanently loaded by GENPR controlled by PLQ8
E5
10-COUNTER
CLOCK (4MHz max.)
SINE WAVE FORMING>10kHz
Divides by 10 in all ranges. Above 10kHz the GENPR input only serves to enable the clock
MA9178

Fig. 13. Routing diagram for waveform selection

Select Lower Range indicator

A front-panel light-emitting diode serves to indicate that too high a range has been selected. The diode is controlled from output 8 of NAND gate F8. The gate inputs are derived from the thousands thumbwheel switch and range signal PLQ12. The light-emitting diode indicates when a 0 is selected on the thousands thumbwheel and ranges x10 or x100 are selected.

3.1.6. Remote Control unit PM 9689/01 (see Fig. 30)

This unit provides a remote BCD programming facility for frequency setting as described in section 2.3.1.
In principle this unit consists of 5 multiplexers, A2, A3, B1, C2 and C3, by means of which local- or remote-control information is fed to the frequency generation part. Selection is provided by controlling the multiplexer G1/G2 inputs via point 18 and 19 of the 24-way plug.

3.1.7. Wave-forming Circuits

The signal clock feeds into one of two divider circuits, depending on the range selected, before passing to either the square-wave amplifier or the sine-wave forming circuits.

3.1.7.1. Dividing circuits for wave-forming

A functional diagram of the two dividing circuits together with a brief outline of their operation is given in Fig. 13.
The relevant circuit blocks are now considered in more detail.

Range control GENPR (Generation Principle)

The logic gates forming this circuit, control which dividers are effective depending on the range selected (alternative principles of sine-wave generation). Above 10 kHz PLQ8 is at logic '0' and therefore output 12 of gate E6 (GENPR) is at logic '1'.
This signal is used via bistable A6 to load the 15-counter C5 so that no division takes place. Below 10 kHz PLQ8 is at logic '1' and therefore output 12 of gate E6 (GENPR) gives logic '1' outputs depending on the outputs of the 15-counter, controlled by $\overline{4CTB1}$.
These GENPR signals provide control for the bistable A6, the 15-counter C5, the 10-counter E5 and the 4-counter C6.

Divider C5 (15-counter)

This divides the signal clock (6 MHz max.) input by 15 in the ranges below 10 kHz; above 10 kHz this counter is is permanently loaded by the logic '1' on GENPR.
Divider C5 is an UP-DOWN counter which counts from 0 to 14 and 14 to 0 depending on the logic state of the square-wave pulses 4CTB1 from the 4-counter in conjunction with a reset pulse on G4.
When 4CTB1 is at logic '0' (G2 at '0'), the counter counts up to 14; it then resets to 0 (inputs 15, 1, 10 and 9 at '0').
When 4CTB1 is at logic '1' (G3 at '1'), the counter counts down from 14 to 0; it then resets to 14 (inputs 1, 10 and 9 at '1', and 15 at '0').
The counter is reset by the load pulse on G4. In order to achieve this, when the counter reaches 0 or 14 the logic '1' output 15CAR on pin 12 is decoded by the range control gates GENPRE and gives a logic '1' on input 12 of bistable A6. In turn, this gives a logic '1' on pin 5 of gate B4 to give a logic '0' on load input G4.

Divider E5 (10-counter)

This divides the signal clock (4 MHz max.) input (E5-14), by ten in the ranges above 10 kHz and divides the output of the 15-counter (D6-12) by ten in the ranges below 10 kHz.
The divider E5 is an UP-DOWN counter which counts from 0 to 9 and 9 to 0 depending on the logic state of the square-wave pulses 4CTB1 from the 4-counter.
When 4CTB1 is at logic '1' (G3 at '1') the counter counts down.
When 4CTB1 is at logic '0' (G2 at '0') the counter counts up from 0 to 9. At 0 and 9, a logic '1' from output 12 (E5CAR) is decoded to produce a logic '1' on G1 in order to block the counter to 0 or to 9 to provide UP-DOWN counting.

Divider C6 (4-counter)

This divides the output of the 10-counter by four in all ranges. It comprises two bistables in cascade the outputs of which provide the 4CTB1 and 4CTB2 square-wave pulses respectively.

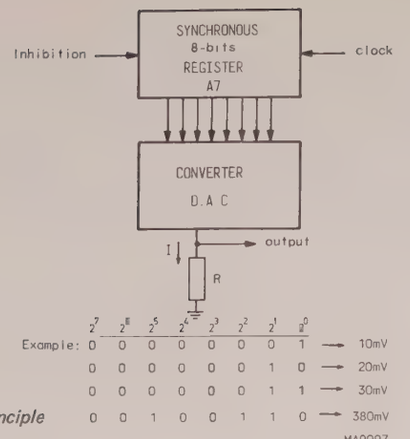


Fig. 14. DAC principle

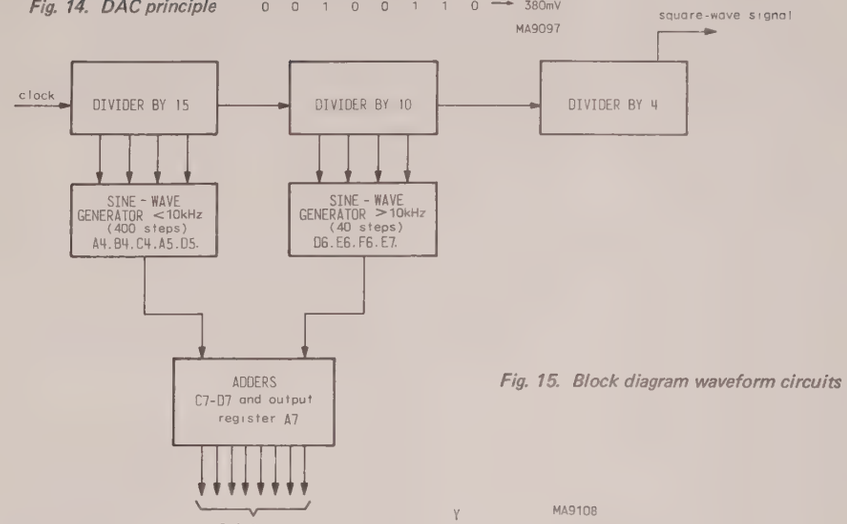


Fig. 15. Block diagram waveform circuits

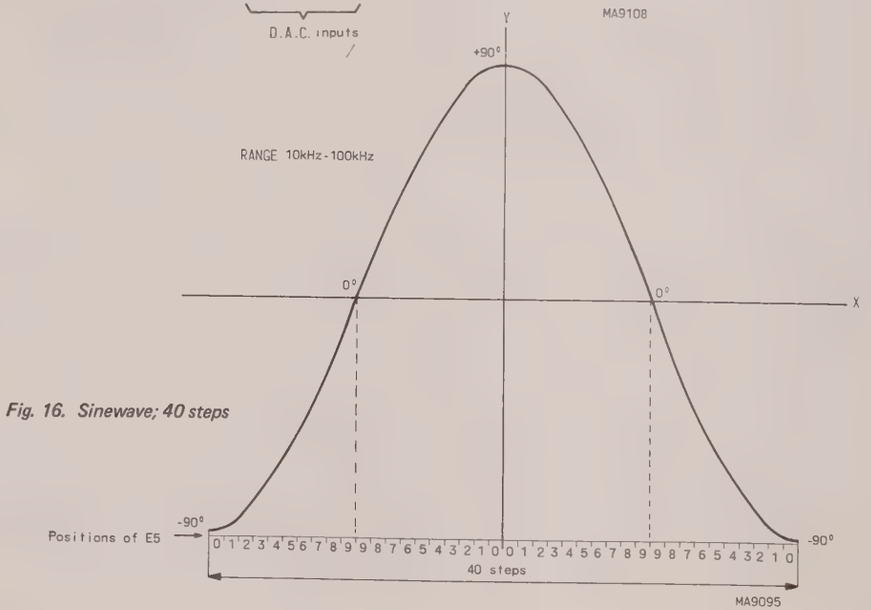


Fig. 16. Sinewave; 40 steps

In ranges above 10 kHz, the input gate to the 4-counter has a logic '1' (GENPR) permanently on B6-1 which enables the E5CAR pulses on B6-2. In ranges below 10 kHz, an input is passed to the 4-counter when the gate pulses GENPR and E5CAR coincide. (The repetition rate of the GENPR pulses will be ten times faster than the E5CAR pulses).

The bistables of the 4-counter, controlled at the command inputs by the signal clock, provide the two square-wave outputs 4CTB1 and 4CTB2, each of equal mark-space ratio. Square-wave 4CTB1 (divide-by-two output) is fed back to the dividers for wave-forming. Square-wave 4CTB2 (divide-by-four output) provides an output for the square-wave amplifier and an output to the sine-forming circuits.

The difference in the dividing circuits above and below 10 kHz can be summerised as follows:

Above 10 kHz the clock has a max. ripple frequency of 12 MHz and after the 3 divider there is no division by 15.

i.e. $\frac{12 \times 10^6}{1} \times \frac{1}{3} \times \frac{1}{1} \times \frac{1}{10} \times \frac{1}{4} = 10^5 \text{Hz}$

(max. ripple clock) (3-counter) (15-counter) (10- counter (4-counter)

Below 10 kHz the clock has a max. ripple frequency of 18 MHz and after the 3 divider there is division by 15:

i.e. $\frac{18 \times 10^6}{1} \times \frac{1}{3} \times \frac{1}{15} \times \frac{1}{10} \times \frac{1}{4} = 10^4 \text{ Hz}$

(max. ripple clock) (3-counter) (15-counter) (10-counter) (4-counter)

3.1.7.2. Sine-wave Generation

3.1.7.2.1. Basic principles of wave-forming

Basically, the rectangular pulses are coded into 8-bit binary numbers corresponding to the relative positions of the sine-wave curve and are applied to a digital-to-analogue converter (D.A.C.).
The D.A.C. gives an output current through a resistor which provides an analogue voltage proportional to the binary code (see Fig. 14).

Coding is achieved by two different principles depending on whether the range is above or below 10 kHz (see Fig. 15).

Above 10 kHz (see Fig. 16, 20, 21), the sine-wave is formed by 40 steps of constant width (angle of rotation) and variable amplitude, produced by the 4 MHz clock.
As there are 40 steps for each sine-wave period, each step corresponds to an angle of 9^o ($360^o/40$).

Therefore, in principle, the 40 steps are built up by progressively selecting the deviation between one step and the next in accordance with a sine-wave table. As the sine-wave amplitude increases (left of the Y axis) the deviation value is added to the value of the previous point, as the sine-wave amplitude decreases (right of the Y axis) the deviation is subtracted.

Below 10 kHz (see Fig. 17 + 18), the sine-wave is formed by 400 steps. In contrast to the higher ranges, these are steps of variable width and constant amplitude. As the amplitude of the sine-wave is 2 $V_{p\text{-}p}$ and the basic step of the D.A.C. is 10 mV, the 400 steps ($2/10^{-3}$) form one complete sine-wave (200 rising, 200 falling). The 400 variable width steps are produced by the selection of the clock pulses. As there are 600 clock pulses during each complete sine-wave, the circuit selects 400 of these to form the variable width steps. As shown in Fig. 17, to simulate the theoretical curve of the sine-wave, the steps of 10 mV must coincide with the 5 mV, 15 mV, 25 mV ... levels.

3.1.7.2.2. Functional description of waveforming

Over the entire frequency range, one period of the selected sine-wave is divided into 40 equal parts. This division is obtained by the decade divider E5 and the divider-by-four, C6. As shown in Fig. 19, square-wave outputs 4CTB1 and 4CTB2 provide a means of selecting the four quadrants of the sine-wave.

As a sine-wave is symmetrical about the X andY axes, the curves in the four quadrants , 1, 2, 3, 4, have identical shapes (P - O = P - O'). Therefore, if the curve in quadrant 1 is built up, it is possible to obtain the remaining curves by homology and symmetry principles under the control of the divider-by-four, which determines the relevant quadrant.

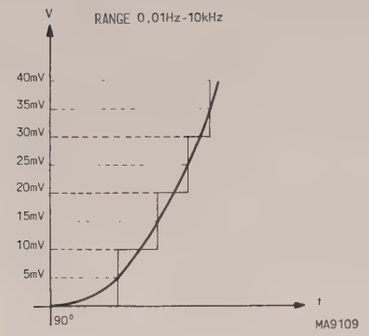


Fig. 17. Sinewave principle < 10 kHz

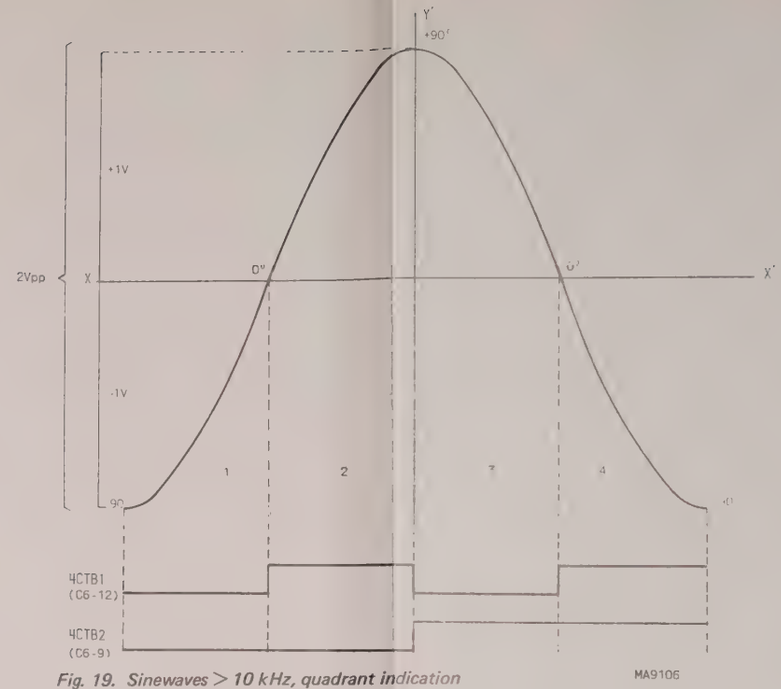


Fig. 19. Sinewaves > 10 kHz, quadrant indication

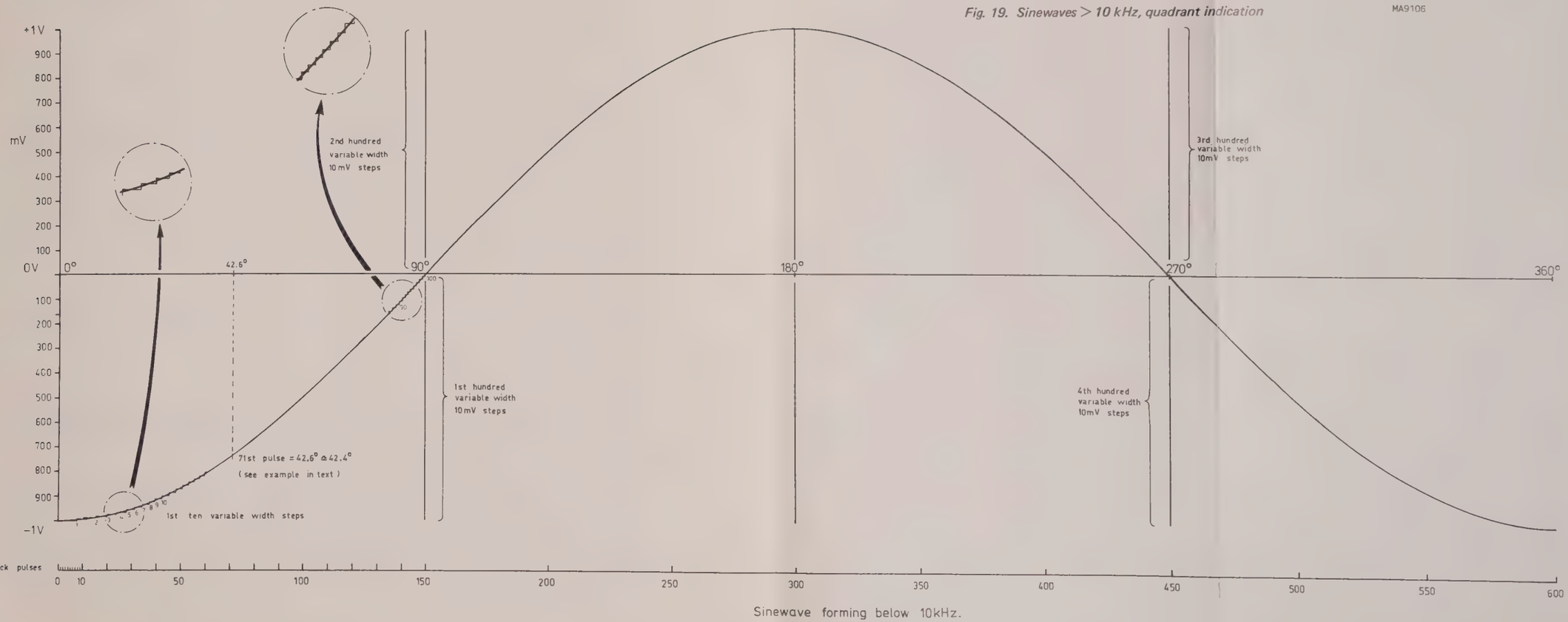


Fig. 18. Sinewave; 400 steps

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Sine-wave forming above 10 kHz (fig. 20)

For sine-wave forming above 10 kHz, as stated previously, the period consists of 40 steps of constant width and variable amplitude, each step corresponding to 9^o. For a specified position $Nx9^o$ of the curve (determined by the position of decade E5 and outputs 4CTB1 and 4CTB2), the next position will be $(N+1)x9^o$. The amplitude deviation between these positions will be added (or subtracted) by means of adders C7 and D7 in conjunction with 8-bit register A7.
For example, if the position selected N, equals $72^o/9^o = 8$, then the next point would be N + 1 = 9.
For a sine-wave of 2 V_{p-p}, bit P8 from the 8-bit register, A7, with the lowest power corresponds, at the output of the D.A.C. to 10 mV as shown in the table below.

Powers	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Bits	P1 ↓ 2^7x10	P2 ↓ 2^6x10	P3 ↓ 2^5x10	P4 ↓ 2^4x10	P5 ↓ 2^3x10	P6 ↓ 2^2x10	P7 ↓ 2x10	P8 ↓ 10
mV	1280	640	320	160	80	40	20	10

The amplitude deviation is dependent on the characteristic shape of the sine curve, being greatest where the curve corsses the X axis. As maximum deviation occurs between the steps 0^o and 9^o (150 mV), the deviation must be decoded by 4 bits from decade E5.

C7B1 – 10 mV
C7B2 – 20 mV
C7B4 – 40 mV
C7B8 – 80 mV
C7CN – 10 mV

B1 + B2 + B4 + B8 = 150 mV maximum.
But, forcing the carry of adder C7 (C7CAR) to '1' results in an addition of the values B1 to CN = 160 mV (see Fig. 21).

As the maximum amplitude deviation between steps is only 160 mV it could be assumed that one 4-bit adder is sufficient. However, since the maximum value of the sine-wave is 2000 mV and the step deviations must be added to those already existing, 8 bits are required, the extra bits being provided by adder D7. During addition, inputs B of D7 are set to zero by the square-wave signal 4CTB2.

In order to obtain homology of the curve with respect to point 0 on Fig. 19, the decade E5 counts backs. while the symmetry of the curve with respect to the Y axis is obtained by subtracting the deviation of the previous value. This binary subtraction is performed by inverting the code of the deviation and the carry by means of exclusive OR gates F6 and register E7.

Register E7

In the range above 10 kHz the amplitude deviation steps, decimal coded in F5, are fed to logic gates E6 and D6. These gates produce a 4-bit binary number which is stored in register E7 and fed to the B inputs at adder C7 by commands on inputs 1 and 8 at E7.

Operation of Adders C7 and D7

When square-waves 4CTB1 and 4CTB2 become zero, the 8-bit register A7 is reset via pin 13. At that moment decade E5 is in position 0, and therefore only bit B1 is at logic '1' at the B inputs of the adders. Consequently, as the A inputs of the adders are connected to the outputs (P1-P8) of register A7, these are at logic '0' as a result of resetting the register.

The result of the addition of two numbers, each of 8 bits, appears immediately at the outputs of the adders. At the next clock-pulse, the resulting 8-digit number is transferred to the register output (inhibit input 1 being high) and is also fed back to inputs A of the adders. Decade E5 is now at position 1 and a new deviation value is coded at inputs B, which is then added to the previous value present on inputs A.

Although the 8-bit register A7 is reset when 4CTB1 and 4CTB2 are at zero, this point actually corresponds to an amplitude of –1 V for a sine-wave of 2 V_{p-p}. An analogue negative shift is provided at the output of the D.A.C. to compensate for this.

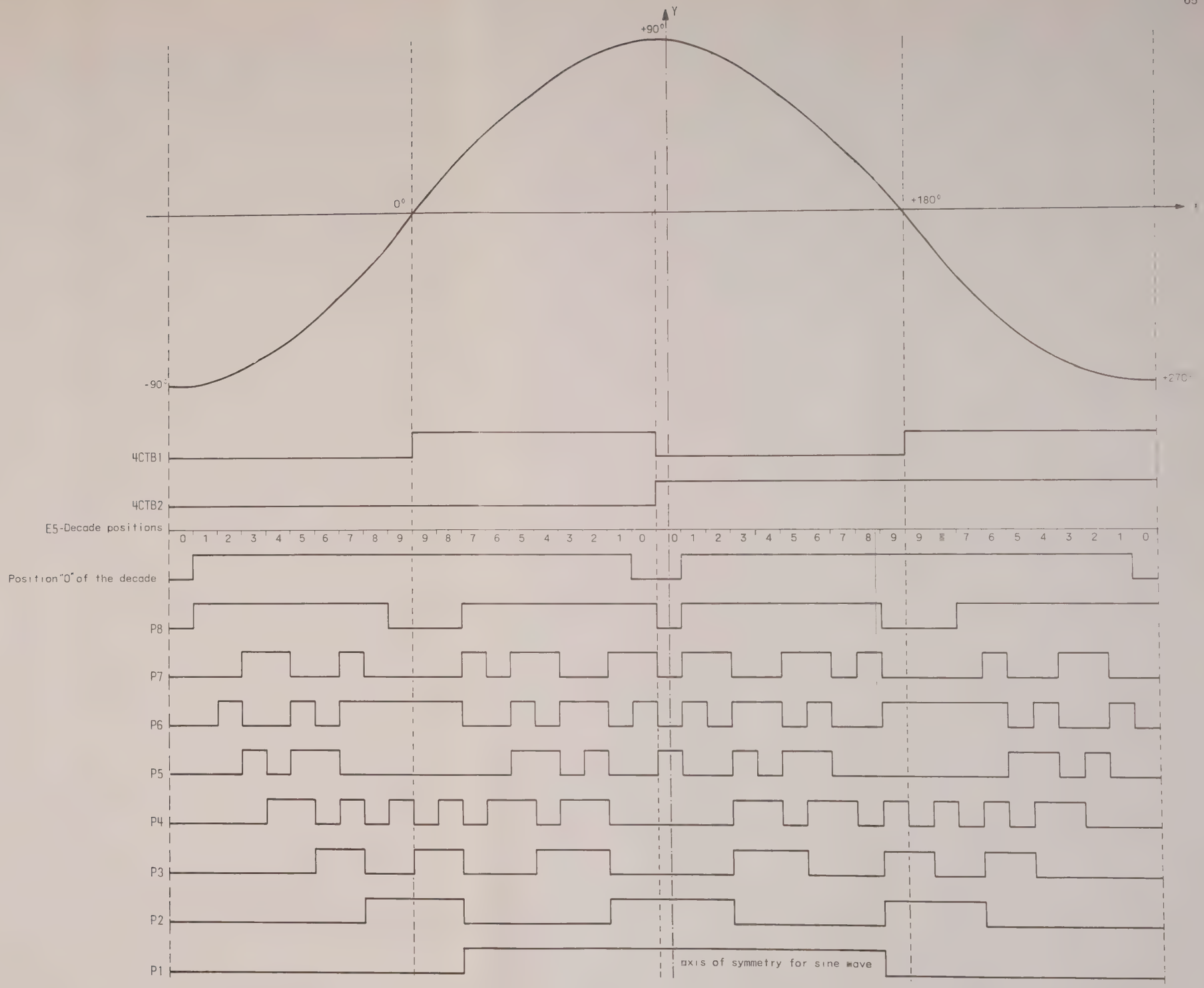


Fig. 20. Detailed pulse sequence > 10 kHz

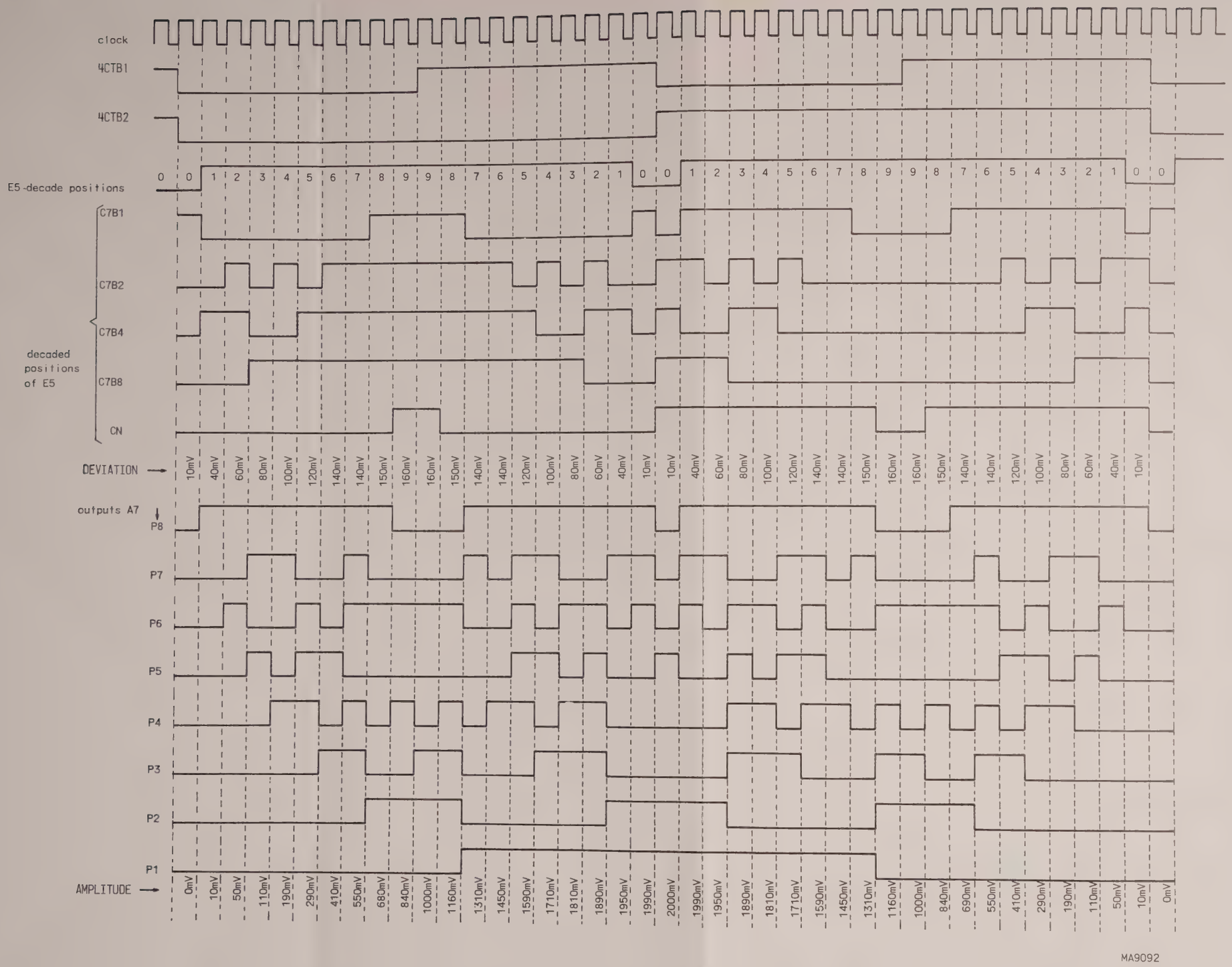


Fig. 21. Detailed pulse sequence > 10 kHz with level indication

Sine-wave forming below 10 kHz (see Fig. 18, 22, 23)

In these ranges, as stated previously, the sine-wave is formed by steps of constant amplitude (10 mV) and variable width. For this purpose, the signal clock is divided by 15 in counter C5, as described in Section 3.3.7.1., before deividing it again by 40.
The 600 clock pulses thus formed are used in conjunction with the decoder to produce 400 pulses. By selecting 400 of the 600 clock pulses the variable width steps can be produced that will form a sinewave. For example, on the steep slope of the curve every clock pulse will be used. As the curve flattens out fewer clock pulses will be selected.

The 10 mV steps are obtained by adding '1' each time to the value determined at the output of the 8-bit register A7. During the negative-going portion of the curve, subtraction is controlled by a logic '0' from the range switch PLQ12 which, in conjunction with 4CTB2 (logic '1' in these quadrants) gives a logic '0' in B1 of C7. In ranges below 10 kHz, register E7 gives only all '0's or all '1's to inputs B2, B4, B8 and CN of adder C7 depending on whether the sinewave is positive-going or negative-going. In other words, for subtraction, the other three B inputs of C7 and the carry (CN) are at logic '1' because input E7-1 is at logic '0' and E7-8 is at logic '1'. For addition, the complement is true. When B1 is at logic '1', the other three B inputs of C7 and the carry (CN) are at logic '0' because inputs E7-1 and E7-8 are at logic '1'.

	B1	B2	B4	B8	CN
For addition	1	0	0	0	0
For subtraction	0	1	1	1	1

Steps of variable width are obtained by controlling the output of register A7 by timing signals from multiplexer A5. Therefore, the result of addition at the register output is enabled only when the A5 multiplexer gives logic '1's on input 1 of A7. Multiplexer A5 is addressed by the 15-counter and by the positions of decade decoder F5 (outputs 1 to 11).

As previously stated, to establish the correct theoretical curve of the sine-wave, a step of 10 mV must be performed when the function passes through 5 mV, 15 mV, etc.

As an example, consider the determining of the position of a step between -90^{o} and -81^{o} (decade E5, 4CTB1 and 4CTB2 all at 0).

From the sine table:

$-1 = \sin -90^{o}$

Therefore, for a step of 5 mV,

$-0.995 = \sin -84.3^{o}$

which gives a deviation of 5.7^{0}.
However, one clock pulse gives a deviation of only 0.6^{o} ($360^{o}/600$).

Therefore, the thenth pulse after -90^{o} must be used ($10 \times 0.6^{o} = 6^{o} \simeq 5.7^{o}$). In this way, the pulse is selected with respect to the positions of the decade as shown in the table below.

Position of the decade E5	Position of counter C5
0	9 (position corresponding to the 10th pulse)
1	0, 5, 9, 13
2	2, 4, 6, 9, 11, 13
3	0, 2, 4, 6, 8, 10, 11, 13
4	0, 1, 3, 4, 6, 7, 9, 10, 12, 13, 14
5	1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14
6	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14
7	0 to 14
8	
9	

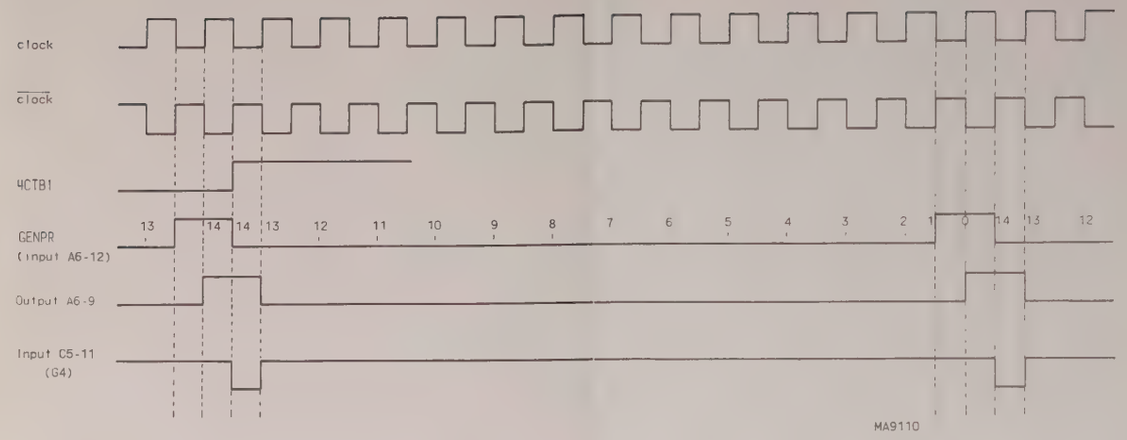


Fig. 22. 15-counter, pulse diagram

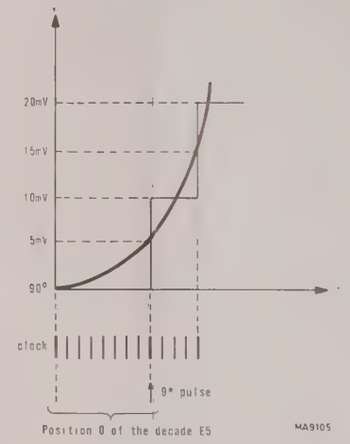


Fig. 23. 10-counter, principle for frequences < 10 kHz

The 8-bit binary information from the shift register A7 of the sine-wave forming circuit is applied to the inputs of the D.A.C. (3ML1). A corresponding analogue output current is passed through resistor 3R6 which corresponds to a potential difference of approximately 900 mV peak-to-peak.

Potentiometer 3R2 serves as a centreing control for the sine-wave at the input of the first amplifier which comprises 3V1, 3V2 and 3V3. The amplifier gain can be adjusted by potentiometer 3R10; the output voltage of the amplifier is approximately 5.4 V_{p-p}. This output voltage is applied via the front-panel AMPLITUDE potentiometer to the second amplifier which comprises 3V4, 3V5 and 3V6 with two associated capacitor networks. This amplifier stage, with frequency dependent feedback, operates as a low-pass filter. Any offset is adjusted by 3R13 (see Fig. 24).

The appropriate capacitor network is switched by relay K1 controlled by a command signal from gate D4-3 on the main card. A logic '1' input for numbers 1 to 3 of the most significant thumbwheel switch energises K1 to bring all capacitors of the filter into circuit. Thus the turn-over frequency is determined by K1.

Freq. selected	D4-3 output	K1	Capacitors	Turn-over freq.
⩽ 39.99 kHz	'1'	energised	3C12//3C13// 3C11//3C14 & 3C9//3C8	90 kHz
> 39.99 kHz	'0'	–	3C12//2C13 & 3C9	230 kHz

The analogue signal thus formed is fed to the sine-wave output via a T-attenuator network, located on the main card, that can be switched in steps of 10-10-20 dB. Correct matching is obtained for an external load of 600 Ω.

3.1.8.2. PM 5142 Output Circuit (Fig. 25, 26, 28)

The PM 5142 output circuits provide for the additional frequency range 100 kHz - 1 MHz.

For frequencies below 100 kHz, the principles described in the previous section for the PM 5141 output circuits generally apply. In this respect, the sine-wave output stages of the PM 5142 card are almost identical to those of the PM 5141 output card and the square-wave output is routed via logic gates on the main card to the same output stage as used in the PM 5141.

The essential circuit differences occur in the 100 kHz - 1 MHz range. Frequencies in this range are derived from the square-wave signal 4CTB2 on the main card. Basically, these are passed to a phase comparator stage where they are compared with a signal fed back from a phaselocked loop. Any phase error is detected and the resulting error voltage is used to control a voltage-controlled oscillator providing triangular pulses. The error voltages control the frequency of these triangular waves depending on the input frequency and also correct the frequency over the phase-locked loop. A Schmitt trigger controls a diode bridge network switching the charging capacitor for the triangular waveform. The Schmitt-trigger also provides the square-wave output for this additional range.

The triangular waveform in the new frequency range is applied to a sine-wave generator consisting of diode-resistor networks. From this point the circuit is selected by a relay contact and passed to the sine-wave amplifier output stage which is common for all ranges.

Square-wave outputs

The logic gates F7 on the main card serve to route the square-wave outputs of the PM 5142 into V7 of the output amplifier. For frequencies below 100 kHz, range command PLQ10 is at logic '0'. Therefore, input 4 of gate F7 is at logic '0' and the logic '1's on inputs 9 and 13 enable the 4CTB2 square-wave to be applied (via F7-12 and F7-10) to V7 as in the case of the PM 5141.

For frequencies above 100 kHz, range command PLQ10 is at logic '1'. The square-wave output from the Schmitt trigger on the PM 5142 output card is therefore routed via F7-5 and F7-9 to V7. The Schmitt trigger also provides the switching signals for the triangular waveform from which the sine-wave above 100 kHz is generated.

Sine-wave outputs below 100 kHz

Below 100 kHz, as mentioned, the circuit is similar to that of the PM 5141. The logic outputs from the register A7 are passed to a D.A.C. (2ML4) and the analogue output voltage across 2R53 is centred by 2R41; 2R50 provides a control of the gain. Relay 2K2 is only energised above 100 kHz (PLQ6 at logic '0'), therefore below 100 kHz the output of the D.A.C. is applied directly to the common output amplifier. The gain of the long-

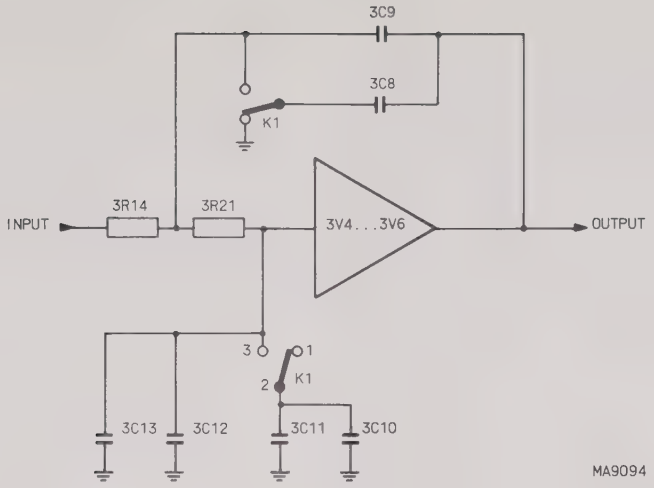
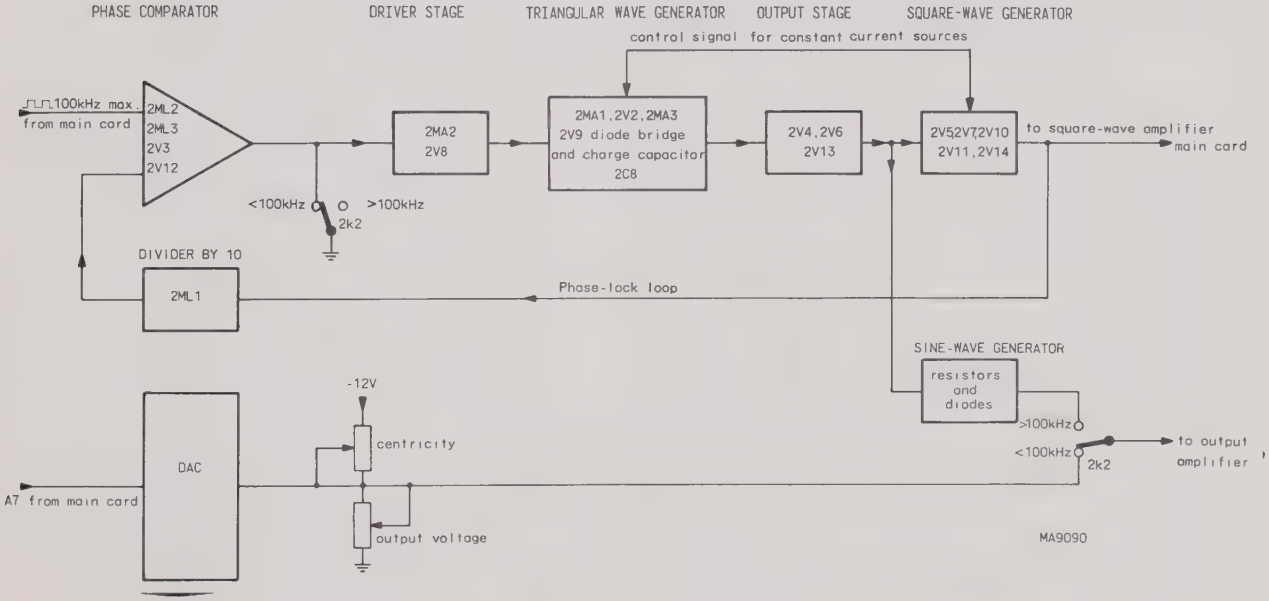


Fig. 24. PM 5141, output circuit, principle diagram



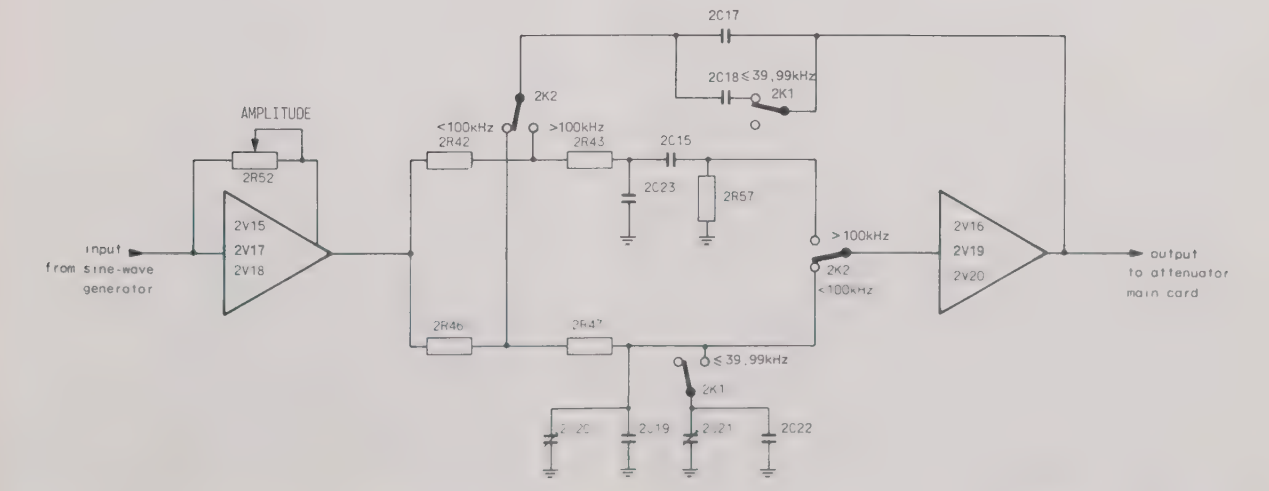


Fig. 25. PM 5142, output circuit, principle diagram

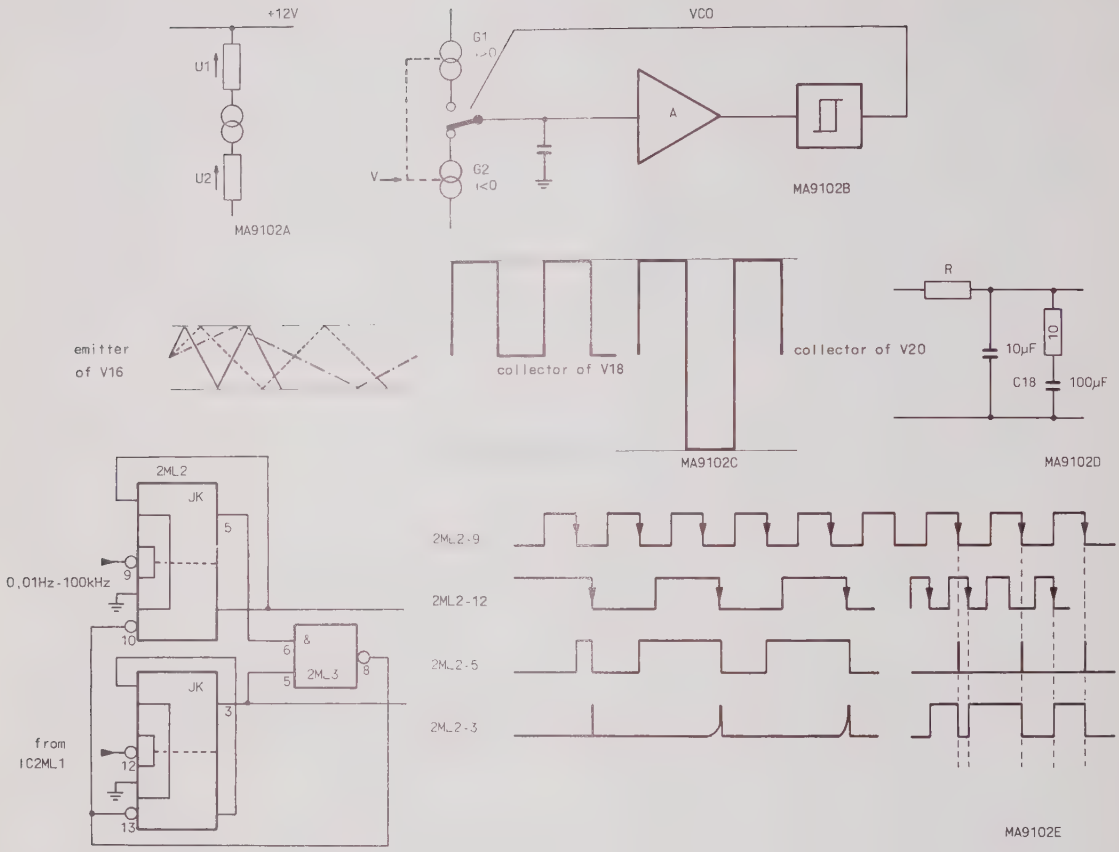


Fig. 26. Details phase-lock-loop principle

tailed pair 2V17, 2V18, can be adjusted by 2R51. The output voltage applied via the front-panel AMPLITUDE control to the second amplifier comprising 2V19, 2V20 and 2V16 with associated capacitor networks. This amplifier stage, with frequency dependent feedback, operates as a low-pass filter. Any offset can be corrected by 2R49. As for the PM 5141, the appropriate capacitors are switched by a relay (2K1) energised for numbers 1 to 3 on the most significant thumbwheel.

Since this output amplifier is common for all ranges, relay 2K2 selects two different resistance-capacity networks for frequencies either above or below 100 kHz. The output voltage above 100 kHz can be adjusted by preset 2C23; below 100 kHz by presets 2C20 and 2C21.
The output attenuator, on the main card, is identical to that for the PM 5141.

Sine-wave outputs above 100 kHz

Sine-waves in the range above 100 kHz are generated by a different principle, as previously described, the output frequency depending on the square-wave frequency applied from the main card. The circuit function can best be described by assuming this frequency (4CTB2) to be 100 kHz. This is the highest possible input frequency and therefore results in the highest possible output frequency; i.e. 1 MHz. The output from the Schmitt trigger also results in a 1 MHz square-wave which is fed back over the phase-lock loop to the command input (12) of the divider-by-ten, 2ML2 as a frequency of 100 kHz. NAND gate 2ML3 serves to trigger the flip-flop of 2ML2. This feedback frequency is compared with the 100 kHz signal at input 9 of 2ML2 from the main card. If these frequencies are the same, difference amplifier 2V3, 2V12 is balanced and no additional control voltage is given for frequency correction. Any deviation, however, results in an error voltage being either added or subtracted from the control voltage determined by the input frequency received from the main card. The control voltage at the driver stage 2V8 is therefore influenced by two signals integrated at input 3 of amplifier 2MA2:
– it varies in accordance with the frequency of the signal from the main card
– it varies in accordance with error signals detected by the comparator 2ML2
This control voltage is passed via amplifiers 2MA1 and 2MA3 to control constant-current sources feeding a diode bridge. The variation results in a frequency variation of the triangular wave-form produced by the voltage-controlled oscillator over the range 100 kHz - 1 MHz. Charge capacitor 2C8 is charged and discharged by the diode bridge at a rate depending on the square-wave output from the Schmitt trigger 2V10, 2V7 as shown in Fig. 19.

Field-effect transistors 2V4 and 2V13 and emitter-follower 2V6 form a high-to-low impedance matching stage. One output feeds the threshold detector, Schmitt trigger 2V10, 2V7. The thresholds occur at approximately 5V and 7V.

Transistors 2V5 and 2V11 convert the trigger output to provide +11 V signal to control the diode gate 2GR7-2GR10 and a 1 V signal from 2V11 emitter to feed 2V14. This transistor provides a signal for the square-wave output circuit and the phase-lock loop signal to divider-by-ten 2ML1.

The other output from emitter-follower 2V6 of the impedance matching stage feeds the sine-wave generator which shapes the triangular waves into sine-waves. Conversion is performed by a diode-resistance network, the characteristics of the diode in the region of the curve being utilised to form the sine curve.
Capacitors 2C3 and 2C11 serve to compensate for the diode capacity of the first stage, which is of most influence. Correction for distortion of the sine-waves is achieved by preset resistors 2R3, 2R12. A resulting sine-wave of 200 mV_{p-p} is available for the output stage via relay contact 2K2-12.

3.1.9. Power Supplies

The synthesizers PM 5141 and PM 5142 operate from a.c. mains supply.

The three secondary windings of the mains transformer each feed a bridge rectifier to provide d.c. supplies of +5 V, +18 V, +12 V and –12 V.

The filtered +18 V supply provides the +12 V supply via the integrated circuit stabiliser V5. Similarly, stabiliser V6 provides the –12 V supply. No adjustment is provided for these supplies.

The +5 V supply comprises the integrated circuit regulator Z1 (SFC 2376 DC) which controls two ballast transistors V3 and V4. The potential dividers R8, P1 and R9 supplies the feedback voltage to the regulator which controls V4 and, in turn, the series transistor V3. In order to ensure a minimum voltage of 9 V at the regulator (point 3) without excessive power dissipation in V3, the regulator and transistor V4 are fed from the filtered +18 V supply rail. By this means, the potential across capacitor C9 can be limited to approximately 6 V. Series resistors R7 (0.2 Ω) limits the output current to protect the circuit against overloading.

3.2. CHECKING AND ADJUSTING

3.2.1. Material required

- Voltmeter for r.m.s. values e.g. Philips PM 2422A
- Oscilloscope without phase shift at 10 kHz e.g. Philips PM 3250
- Frequency meter e.g. Philips PM 6620
- Distortion meter e.g. HP 331A

3.2.2. 5 V supply

- Adjust this voltage +5 V ± 2 %

3.2.3. Output circuit for PM 5141

- Read out 99,99 Hz; potentiometer at the front to maximum
- Adjust the amplitude to a maximum of 3.60 V_{rms} on 600 Ω. Adjusting element: 3R10
- Check that the attenuation of potentiometer AMPLITUDE at the front is ⩾ 20 dB ($U \leqslant 0{,}36\ V_{rms}$)
- Centricity of the sine wave:
  - Unsolder the connections of potentiometer AMPLITUDE and connect the input of the second amplifier to chassis. Adjust offset to zero with 3R13.
  - Resolder the connection and adjust the centricity of the sine-wave curve with 3R2.

3.2.4. Output circuit for PM 5142

3.2.4.1. Position x100 (range 100 kHz - 1 MHz)

- Set thumb-wheel switches to position 5000.
  - Connect a distortion meter to output ~/600 Ω
  - Adjust potentiometers 2R12 and 2R3 (2,2 k) alternately to obtain a minimum distortion (typical: < 0,5 %
- Set thumb-wheel switches to position 1000
  - Adjust potentiometer 2R63 to obtain a minimum distortion
- Connect a r.m.s. voltmeter to output ~/600 Ω.
  - Set potentiometer AMPLITUDE to maximum
  - Adjust the centricity of the sine-wave curve on an oscilloscope. Adjusting element: 2R49.
- Set thumb-wheel switches to position 9999
  - Adjust trimmer 2C23 to obtain 3,60 V_{rms} on output ~/600 Ω (tolerance: 1 %).

3.2.4.2. Position x10 (range < 100 kHz)

- Set thumb-wheel switches to position 1000
  - Adjust potentiometer 2R50 to obtain 3,60 V_{rms} on output ~/600 Ω
  - Adjust the centricity of the sine wave curve on an oscilloscope. Adjusting element: 2R41
- Set thumb-wheel switches to position 9999
  - Adjust trimmer 2C20 to obtain 3,60 V_{rms} on output ~/600 Ω
- Set thumb-wheel switches to position 3999
  - Adjust trimmer 2C21 to obtain 3,60 V_{rms} on output ~/600 Ω

3.3. LIST OF PARTS (PM 5141 + PM 5142)

3.3.1. MECHANICAL PARTS

ITEM	FIG.	QTY.	ORDERING NUMBER	DESCRIPTION
1	36a	4	5322 298 54056	GRIP
2	37	4	5322 462 44196	SUPPORT-REAR
3	36a	8	5322 256 94076	FOOT-HOLDER
4	36a	8	5322 462 44195	FOOT
5	36a	4	5322 462 14008	TILTING BRACKET
6	37	4	5322 447 94227	COVER-PLATE
7	36a	8	5322 460 64011	ORNAMENTAL STRIP
8	36a	2	5322 414 34151	KNOB
9	36a	2	5322 276 34023	PUSH-BUTTON SWITCH 3
10	36a	2	5322 273 14028	THUMBWHEEL SWITCH 4
11	36a	4	5322 267 10004	CONNECTOR
12	36a	2	5322 277 10169	ON/OFF-SWITCH
13	38	16	5322 401 14234	SLIDING HOLDER PM 5141 - ONLY
14	36b	1	5322 455 74039	TEXT PLATE
15	36b	1	5322 276 44039	PUSH-BUTTON SWITCH 4 PM 5142-ONLY
16	36a	1	5322 455 74038	TEXT PLATE
17	36a	1	5322 267 54101	PUSH-BUTTON SWITCH 5
18	38,39	4	5322 462 34149	GUIDE PART
19	38,39	8	5322 255 44113	HEAT SINK CO 376

3.3.2. ELECTRICAL PARTS

3.3.2.1. RESISTORS

MAIN CARD

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R6	4822 110 63076	68	5	0,33	CARBON
R8	4822 110 63123	3,9K	5	0,33	CARBON
R9	4822 110 60115	2K	5	0,33	CARBON
R7	5322 113 44179	0,2	10	2W	WIRE-WOUND
P1	5322 101 14047	470	20	CP=0,5	TRIMMING POTM
R5,R39	4822 110 63098	470	5	0,33	CARBON
R2,R38	4822 110 63107	1K	5	0,33	CARBON
R4	4822 110 63125	4,7K	5	0,33	CARBON
R3	4822 110 63134	10K	5	0,33	CARBON
R36,R42	4822 110 63087	180	5	0,33	CARBON
R41	4822 110 63134	10K	5	0,33	CARBON
R37	4822 110 63123	3,9K	5	0,33	CARBON
R40	4822 110 63136	12K	5	0,33	CARBON
R1	4822 110 63141	18K	5	0,33	CARBON
R43,R16,R19	4822 110 63134	10K	5	0,33	CARBON
R13	4822 110 63054	10	5	0,33	CARBON
R12	4822 110 63081	100	5	0,33	CARBON
R14	4822 110 63096	390	5	0,33	CARBON
R10	4822 110 63098	470	5	0,33	CARBON
R11	4822 110 63101	560	5	0,33	CARBON
R20,23,25,28	5322 116 54509	309	1	0,25	METAL FILM
R22,27	5322 116 50459	422	1	0,25	METAL FILM
R30,33	5322 116 50508	487	1	0,25	METAL FILM
R32	5322 116 54476	121	1	0,25	METAL FILM
R21,24,26,29	4822 110 63038	2,7	5	0,33	CARBON
R31,34	4822 110 63043	3,9	5	0,33	CARBON
R35	4822 110 63085	150	5	0,33	CARBON
R15+PARA	4822 110 53081	100	5	0,5	CARBON
OUTPUT CARD	PM5142				
2R38	4822 110 63136	12K	5	0,33	CARBON
2R36,37,39,40	4822 110 63109	1,2K	5	0,33	CARBON
2R54	4822 110 60133	9,1K	5	0,33	CARBON
2R11,15,17,31, 35,50	4822 110 63107	1K	5	0,33	CARBON
2R28	4822 110 63092	270	5	0,33	CARBON
2R62	4822 110 60115	2K	5	0,33	CARBON
2R47	4822 110 63161	100K	5	0,33	CARBON
2R60	5322 116 50094	430	5	0,5	METAL FILM
2R8,23	4822 110 63081	100	5	0,33	CARBON
2R18,58	4822 110 63121	3,3K	5	0,33	CARBON
2R7,16,22,25	4822 110 63116	2,2K	5	0,33	CARBON
2R24	4822 110 63054	10	5	0,33	CARBON
2R4,32,	5322 116 54619	10K	1	0,25	METAL FILM
2R46	5322 116 50593	16,2K	1	0,25	METAL FILM
2R47	5322 116 54003	22,1K	1	0,25	METAL FILM
2R1,2,26,27	5322 116 54557	1,21K	1	0,25	METAL FILM
2R59	5322 116 54005	3,32K	1	0,25	METAL FILM
2R9,10	5322 116 54564	1,50K	1	0,25	METAL FILM
2R29	5322 116 54536	750	1	0,25	METAL FILM
2R5,33	5322 116 50572	12,1K	1	0,25	METAL FILM
2R6,34	5322 116 54642	20K	1	0,25	METAL FILM
2R13	5322 116 54481	130	1	0,25	METAL FILM
2R14	5322 116 54496	200	1	0,25	METAL FILM
2R19	5322 116 50437	243	1	0,25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
2R41	5322 101 14067	4,7K	20	0,5-CP	TRIMMING POTM
2R49	5322 100 10116	100K	20	0,5-CP	TRIMMING POTM
2R12	5322 101 14072	100	20	0,5-CP	TRIMMING POTM
2R50	5322 101 14072	100	20	0,5-CP	TRIMMING POTM
2R3	5322 100 10117	2,2K	20	0,5-CP	TRIMMING POTM
2R63	5322 101 14066	10K	20	0,5-CP	TRIMMING POTM
2R57	4822 110 63145	27K	5	0,33	CARBON
2R42	4822 110 63085	150	5	0,33	CARBON
2R43	4822 110 60102	620	5	0,33	CARBON
2R70	4822 110 63072	47	5	0,33	CARBON
2R63	5322 116 50583	5,9K	1	0,25	METAL FILM
2R53	4822 110 63098	470	5	0,33	CARBON
2R52	5322 101 24089	1K-LIN	20	0,5	CARBON POTM LIN
2R51	5322 101 14145	22	20	0,5	TRIMMING POTM
2R45	4822 110 60055	11	5	0,33	CARBON
2R61	5322 116 50561	590	1	0,25	METAL FILM
2R55	4822 110 63076	68	5	0,33	CARBON
OUTPUT CARD	PM5141				
3R6	4822 110 63101	560	5	0,33	CARBON
3R3,4,17,18	4822 110 63109	1,2K	5	0,33	CARBON
3R1	4822 110 60137	13K	5	0,33	CARBON
3R25,26	4822 110 60115	2K	5	0,33	CARBON
3R5	4822 110 60128	6,2K	5	0,33	CARBON
3R7,24	4822 110 60133	9,1K	5	0,33	CARBON
3R12,16	4822 110 63152	47K	5	0,33	CARBON
3R15	4822 110 63161	100K	5	0,33	CARBON
3R22	4822 110 63101	560	5	0,33	CARBON
3R8	4822 110 63107	1K	5	0,33	CARBON
3R20,23	5322 116 54619	10K	1	0,25	METAL FILM
3R14	5322 116 54606	7,15K	1	0,25	METAL FILM
3R21	5322 116 54629	14K	1	0,25	METAL FILM
3R10	5322 101 14049	470	20	0,5	TRIMMING POTM
3R9	4822 110 63107	1K	5	0,33	CARBON
3R?	5322 101 14067	4,7K	20	0,5	TRIMMING POTM
3R13	5322 100 10116	100K	20	0,5	TRIMMING POTM
3R19	5322 116 50561	590	1	0,25	METAL FILM
3R11	5322 116 54474	110	1	0,33	METAL FILM
PROGRAMMING	CARD				
R1	4822 110 63081	100	5	0,33	CARBON
R2	4822 110 63134	10K	5	0,33	CARBON
R3	4822 110 63107	1K	5	0,33	CARBON

3.3.2.2. CAPACITORS

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
CAPACITORS					
MAIN CARD					
C9	5322 124 24117	4700M		16	ELECTROLYTIC
C11,13	4822 124 20527	470M		25	ELECTROLYTIC
C10	5322 124 24128	470M		10	ELECTROLYTIC
C5	4822 122 31205	47P	20 10	500	CERAMIC PLATE
C7,8	4822 120 21134	10N	-20+50	500	CERAMIC
C17-23	4822 120 21125	4700P	-20+50	500	CERAMIC
C12,14	4822 124 20475	10M		16	ELECTROLYTIC
C27	4822 121 41161	0,1M	20	250	POLYESTER FOIL
C2	4822 122 31205	47P	5		CERAMIC PLATE
C3	4822 122 31166	560P	-20+50	500	CERAMIC PLATE
C4	4822 120 21134	10N	-20+100	500	CERAMIC
C1		470P	10	500	TRIMMING POTM
C28	5322 125 54043	7-35P			TRIMMER
C16	4822 124 20496	10M		35	ELECTROLYTIC
OUTPUT CARD	PM5142				
2C19,24	4822 122 31203	39P	5		CERAMIC PLATE
2C22	4822 122 31211	100P	5		CERAMIC PLATE
2C17	4822 122 31207	68P	5		CERAMIC PLATE
2C18	4822 122 31218	120P	5		CERAMIC PLATE
2C8	4822 122 31166	560P	5		CERAMIC PLATE
2C3,11	4822 122 31218	120P	5	500	CERAMIC PLATE
2C7	4822 122 31173	220P	5	500	CERAMIC PLATE
2C16	4822 122 31194	8,2P	5	500	CERAMIC PLATE
2C27,28	4822 122 31116	2200P	-20+50	500	CERAMIC PLATE
2C1,6,13,	4822 121 41161	0,1M	20	250	POLYESTER FOIL
2C2,4,5,9,12, 14,26	4822 124 20475	10M	-10+50	16	ELECTROLYTIC
2C10	4822 124 20462	100M	-10+50	6	ELECTROLYTIC
2C20,21,23	5322 125 54042	10-60P			TRIMMER
OUTPUT CARD	PM5141				
3C3,7	4822 122 31195	10P	5 5	00	CERAMIC PLATE
3C12	4822 122 31207	39P	5		CERAMIC PLATE
3C9	4822 122 31207	68P	5		CERAMIC PLATE
3C11	4822 122 31211	100P	5		CERAMIC PLATE
3C8	4822 122 31218	120P	5		CERAMIC PLATE
3C10,13	5322 125 54042	10-60P			TRIMMER
3C14	4822 122 31116	2200P	20 10	500	CERAMIC PLATE
3C1,6	4822 121 41161	0,1M	20	250	POLYESTER FOIL
3C2,4,5	4822 124 20475	10M		16	ELECTROLYTIC
PROGRAMMING	CARD				
C1	4822 124 20475	10M		25	ELECTROLYTIC

3.3.2.3. SEMI–CONDUCTORS

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
TRANSISTORS		
MAIN CARD		
V3	5322 130 44437	BD283
V4	5322 130 44438	BD284
V1,2,9	5322 130 40495	2N709
V7	5322 130 40495	2N709
V8	5322 130 40016	2N2218
OUTPUT CARD	PM5142	
2V15	5322 130 44543	BC153
2V17,18,19,20	5322 130 44301	BC183
2V16	5322 130 40528	2N2904A
2V21	5322 130 44289	BC182
2V3	5322 130 40207	2N3702
2V8,9,12	5322 130 40399	2N3605
2V4,13	5322 130 44544	E201
2V6,7,10,11	5322 130 44047	2N2369A
2V14	5322 130 44047	2N2369A
2V?	5322 130 44545	MPS6519
OUTPUT CARD	PM5141	
3V1,2,5,6	4822 130 40937	BC183B
3V3	5322 130 44543	BC153
3V4	5322 130 40528	2N2904A
3V7	5322 130 44289	BC182
PROGRAMMING	CARD	
V1	5322 130 40919	BD228
V2	5322 130 44289	BC182
REGULATORS		
MAIN CARD		
Z1	5322 209 85038	SFC2376 DC
V5,6	5322 209 85043	TBA625 BX
OUTPUT CARD	PM5142	
2V1	5322 209 85044	MA78M12HC
DIODES		
MAIN CARD		
CR1	5322 130 34409	BY204115
CR2,3	5322 130 34411	WOI IA
CR4	5322 130 34549	34P4
OUTPUT CARD	PM5142	
2GR1-16	5322 130 34502	IN914A
2GR17	5322 130 34189	BAV20
OUTPUT CARD	PM5141	
3GR1	5322 130 34189	BAV20
PROGRAMMING	CARD	
GR1	5322 130 34189	BAV20
INTEGRATED CIRCUITS		
MAIN CARD		
A2,B2	5322 209 84404	SN74160
D3,E3	5322 209 84299	SN74166
D2,E2	5322 209 85042	SN74167
F3	5322 209 84296	SN74157
C1,D1,F5	5322 209 84668	SN74190
C5	5322 209 84403	SN74191
A1,B1	5322 209 84238	SN74H73
A5	5322 209 84034	SN74150
F5	5322 209 80142	SN7442
C6	5322 209 80073	SN7473
A6	5322 209 84165	SN7474

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
A7	5322 209 85041	SN74198N
C2	5322 209 84475	SN74S04
A3,C3	5322 209 84167	SN74S00
B3	5322 209 84954	SN74S10
B4,D6,E4	5322 209 84528	SN7400
A4,B6,D4	5322 209 80151	SN7408
C4,E6	5322 209 80077	SN7410
F2,F4,D5	5322 209 80148	SN7404
F6	5322 209 84201	SN7486
E7	5322 209 85032	SN74H87
F8	5322 209 80138	SN7430N
PM5142-ONLY		
F7	5322 209 84528	SN7400N
OUTPUT CARD	PM5142	
2ML4	5322 218 64053	DAC98B1
2ML2	5322 209 84023	SN74107
2ML3	5322 209 80138	SN7430
2ML1	5322 209 80072	SN7490
2MA2,3	5322 209 84342	SN72741L
2MA1	5322 209 84342	MC1741CG
OUTPUT CARD	PM5141	
3ML1	5322 218 64053	DAC98B1
PROGRAMMING	CARD	
A2,A3,B1,C2, C3	5322 209 84296	SN74157
A4,B4,C4	5322 209 80148	SN7404
A1	5322 209 80234	SN7402
C1	5322 209 84531	SN7420

3.3.3. MISCELLANEOUS

ITEM	FIG	QTY	ORDERING NUMBER	DESCRIPTION
20	36a	2	5322 130 34412	L.E.D.
21	37	2	5322 272 14013	VOLTAGE ADAPTOR
22	38	2	5322 146 34058	TRANSFORMER, T
23	38	2	5322 158 14155	COIL, 1L2
24	38	2	5322 242 74068	CRYSTAL 18MC SERIE
25	39	2	5322 280 84061	RELAY A2417 18V/500
26	39	2	5322 280 84062	RELAY A2612 18V/500
27	39	2	5322 255 44133	TRANSISTOR SPACER
28	39	2	5322 265 64064	CONNECTOR 25 MALE
29	39	2	5322 267 74044	CONNECTOR 25 FEMALE
30	38	101	5322 268 14092	SINGLE PIN FOR CONN.
31	38	3	5322 268 34013	CONTACT HOLDER 36POS
32	38	101	5322 268 24069	CONTACT FOR HOLDER
33	37	2	5322 256 40017	FUSE HOLDER
34	37	2	4822 253 30011	FUSE 180MA T20D
35	37	1	5322 267 60008	SOCKET 24 CONTACTS
–	–	1	5322 264 60011	PLUG 24 CONTACTS
–	–	2	5322 321 10071	MAINS CABLE

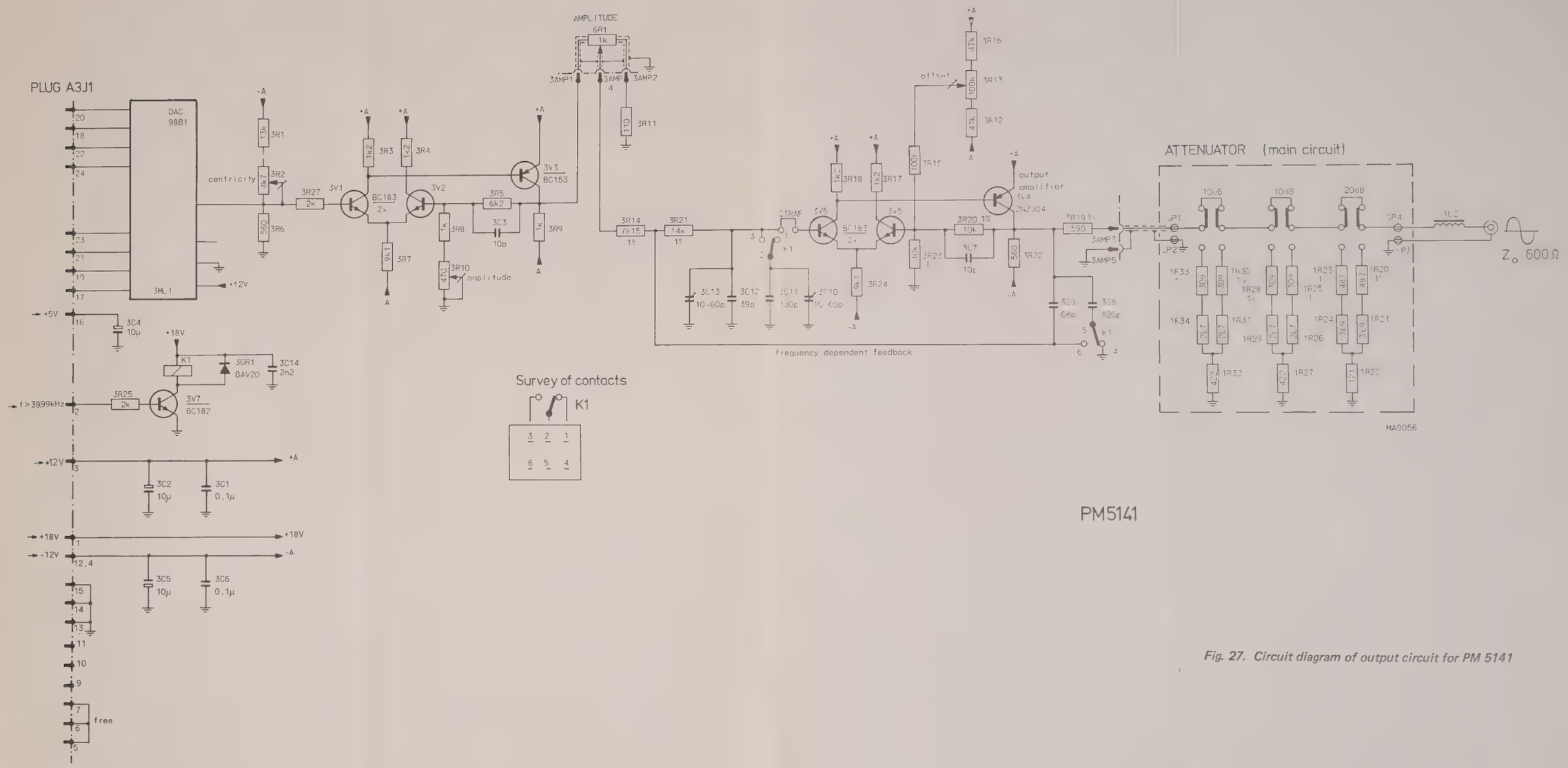


Fig. 27. Circuit diagram of output circuit for PM 5141

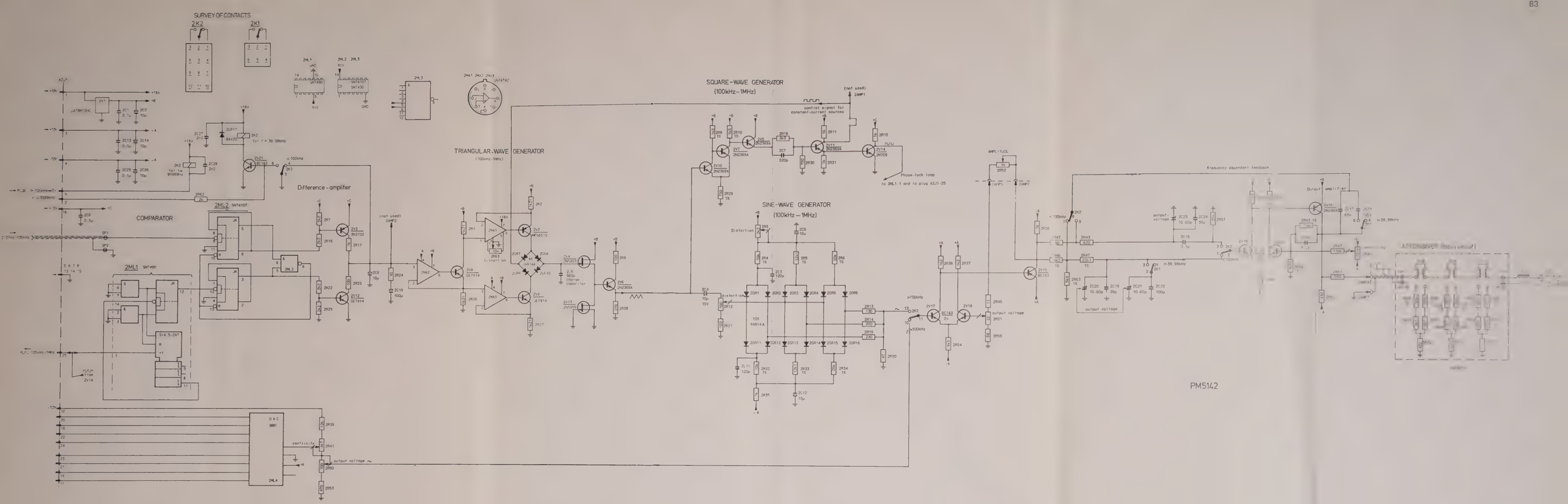


Fig. 28. Circuit diagram of output circuit for PM 5142

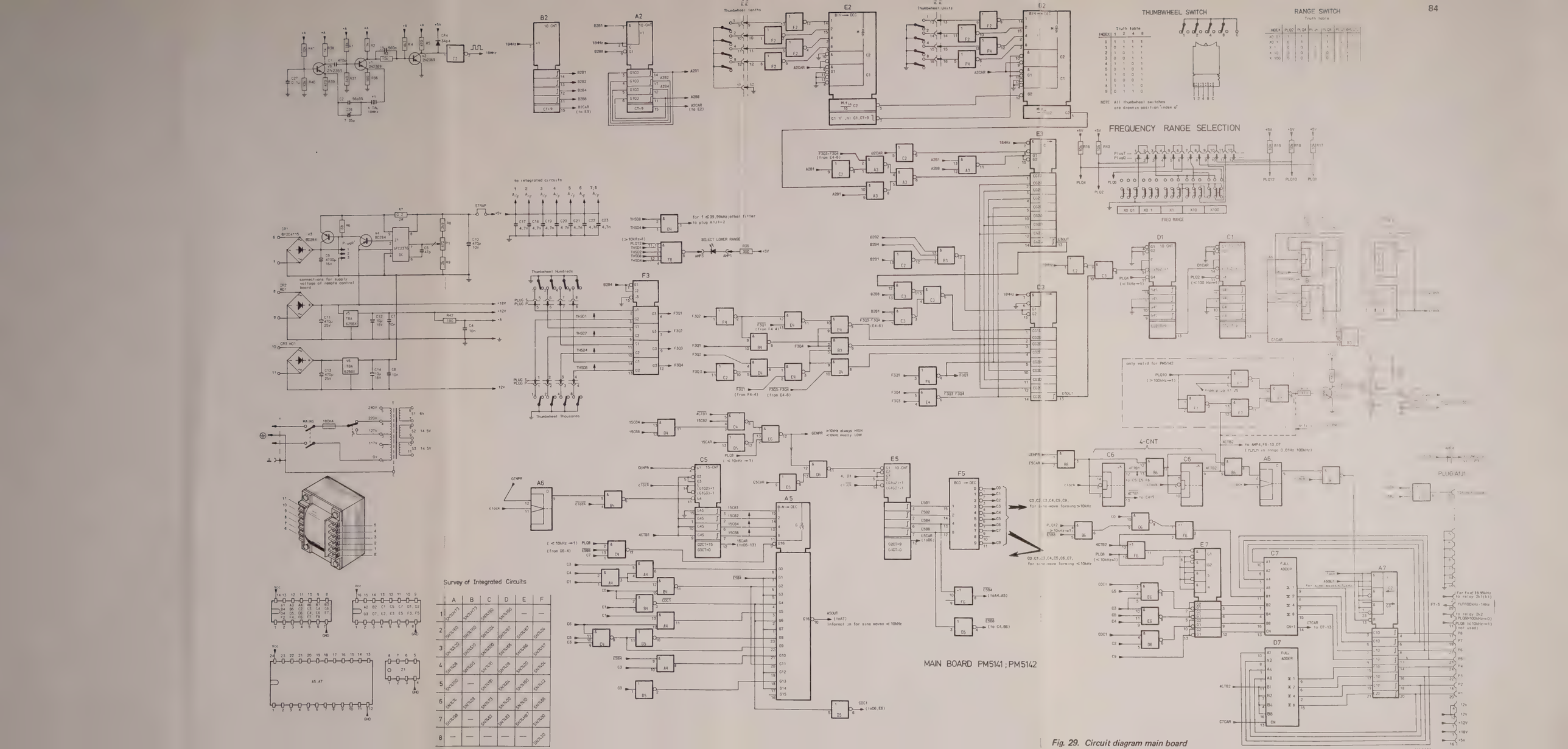


Fig. 29. Circuit diagram main board

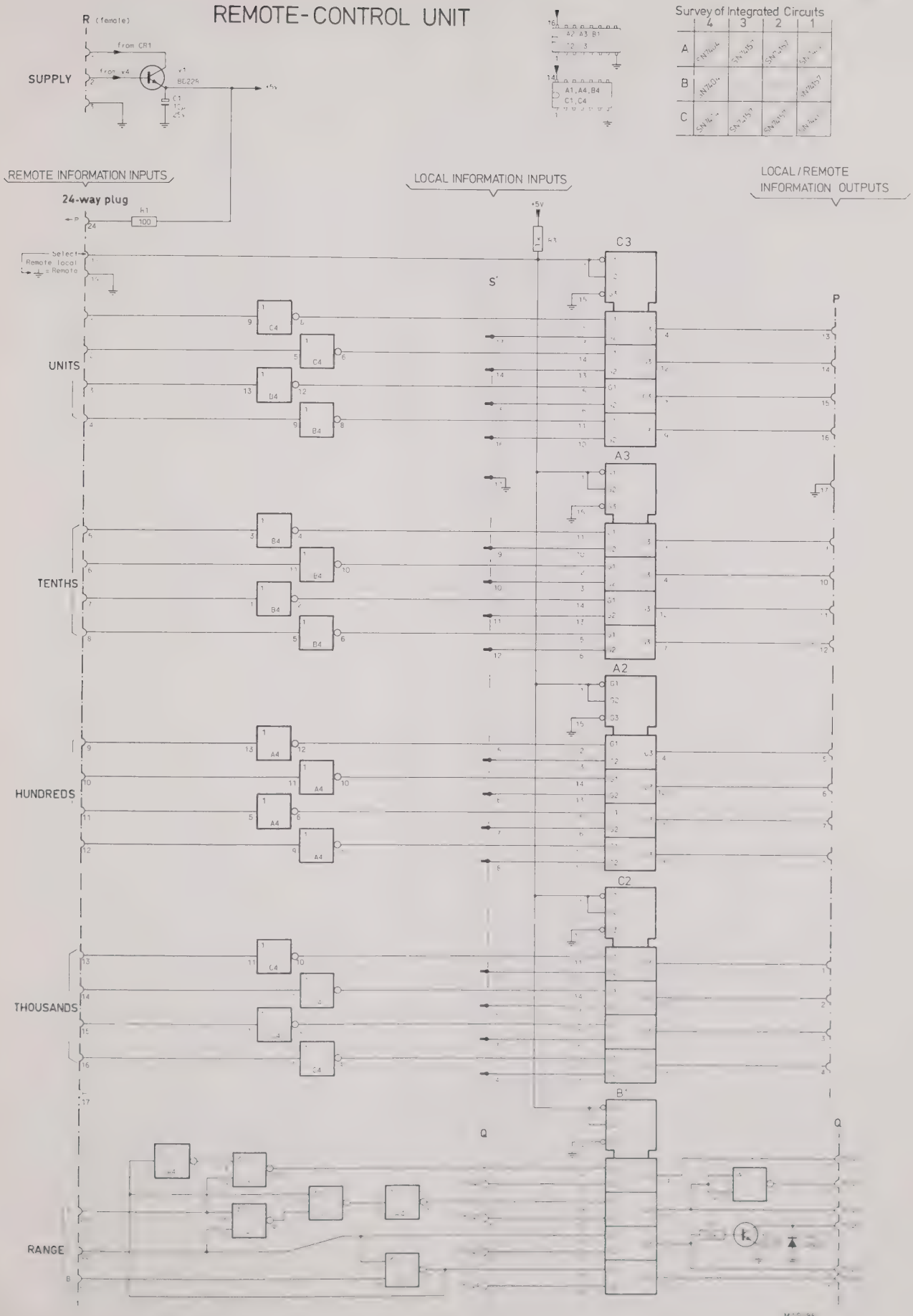


Fig. 30. Circuit diagram remote control unit

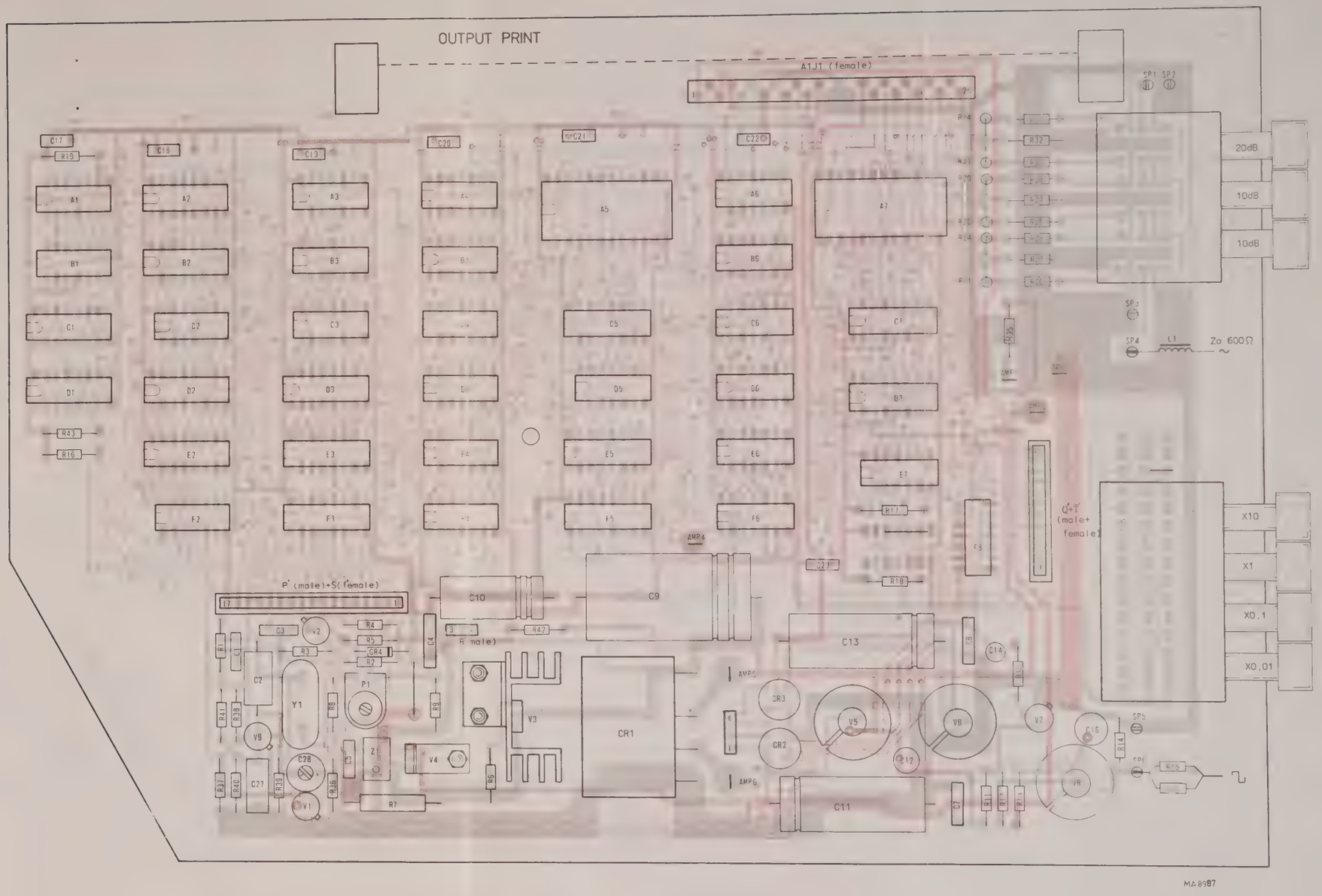


Fig. 31. p.w.b. main board for PM 5141

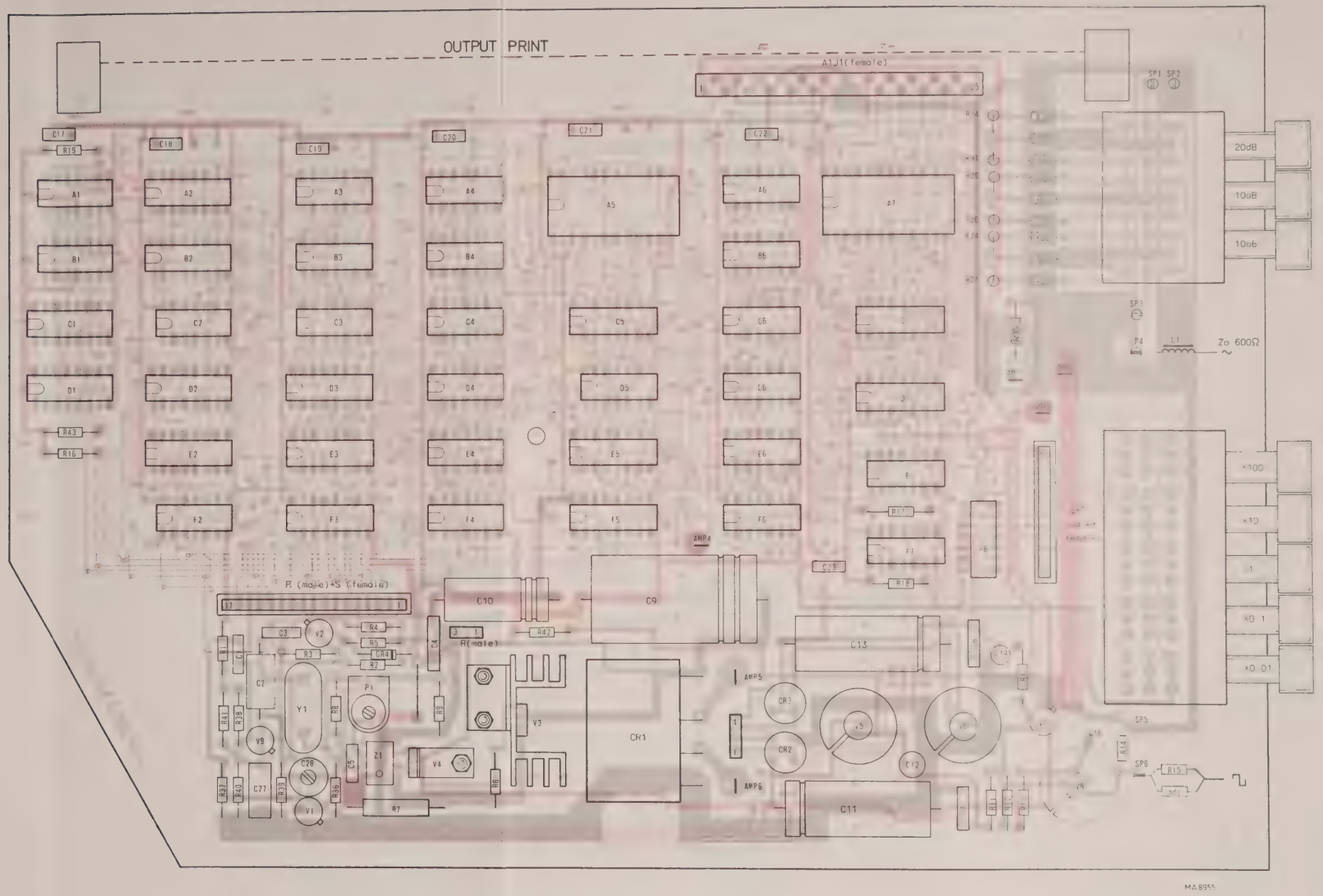


Fig. 32. p.w.b. main board for PM 5142

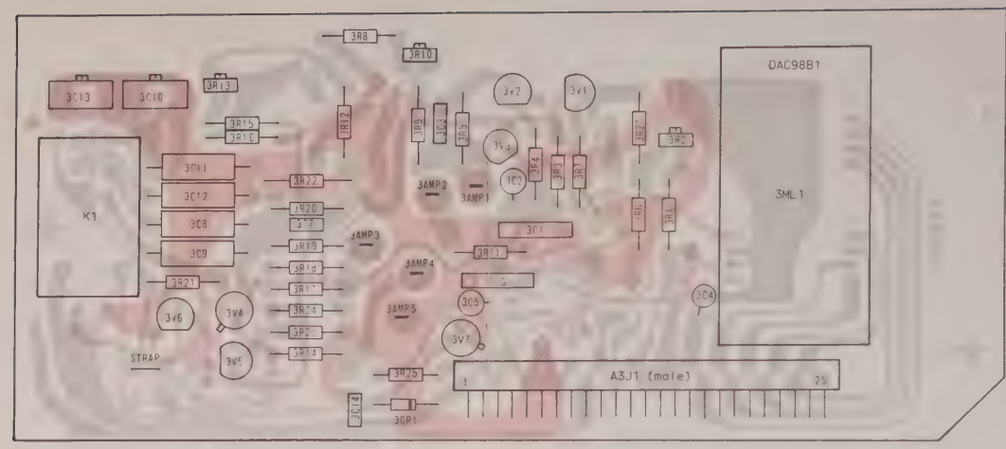


Fig. 33. p.w.b. output card for PM 5141

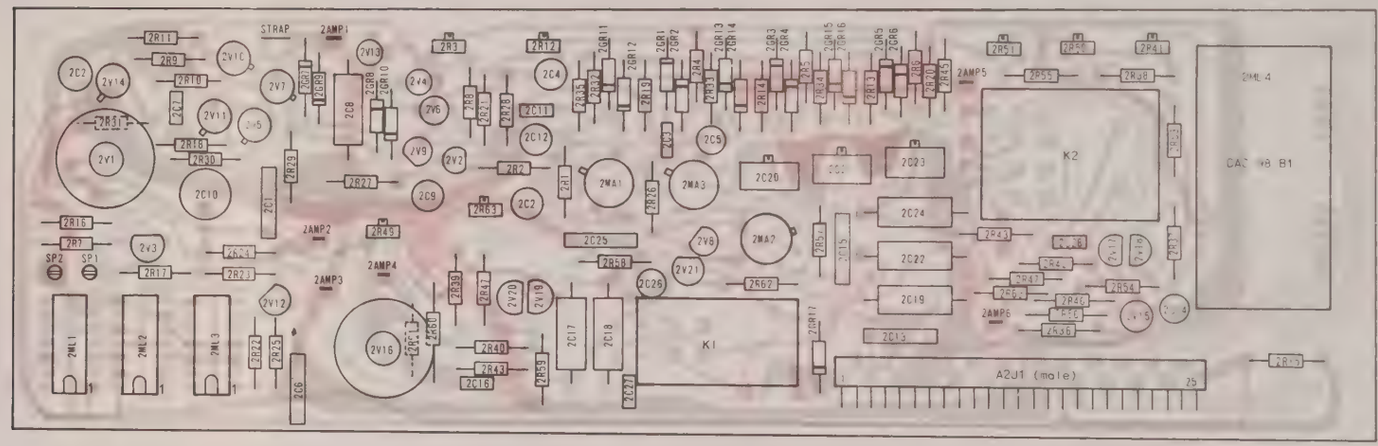


Fig. 34. p.w.b. output card for PM 5142

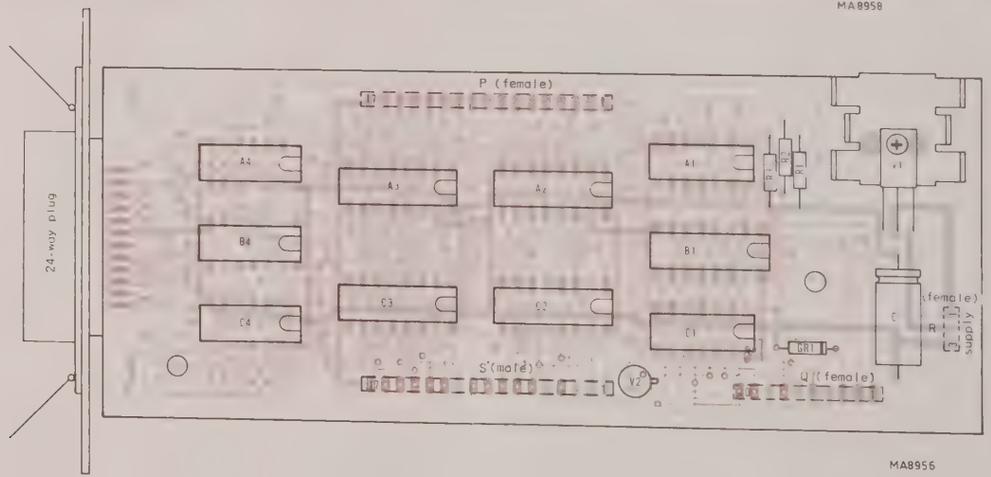


Fig. 35. p.w.b. output card for remote control unit

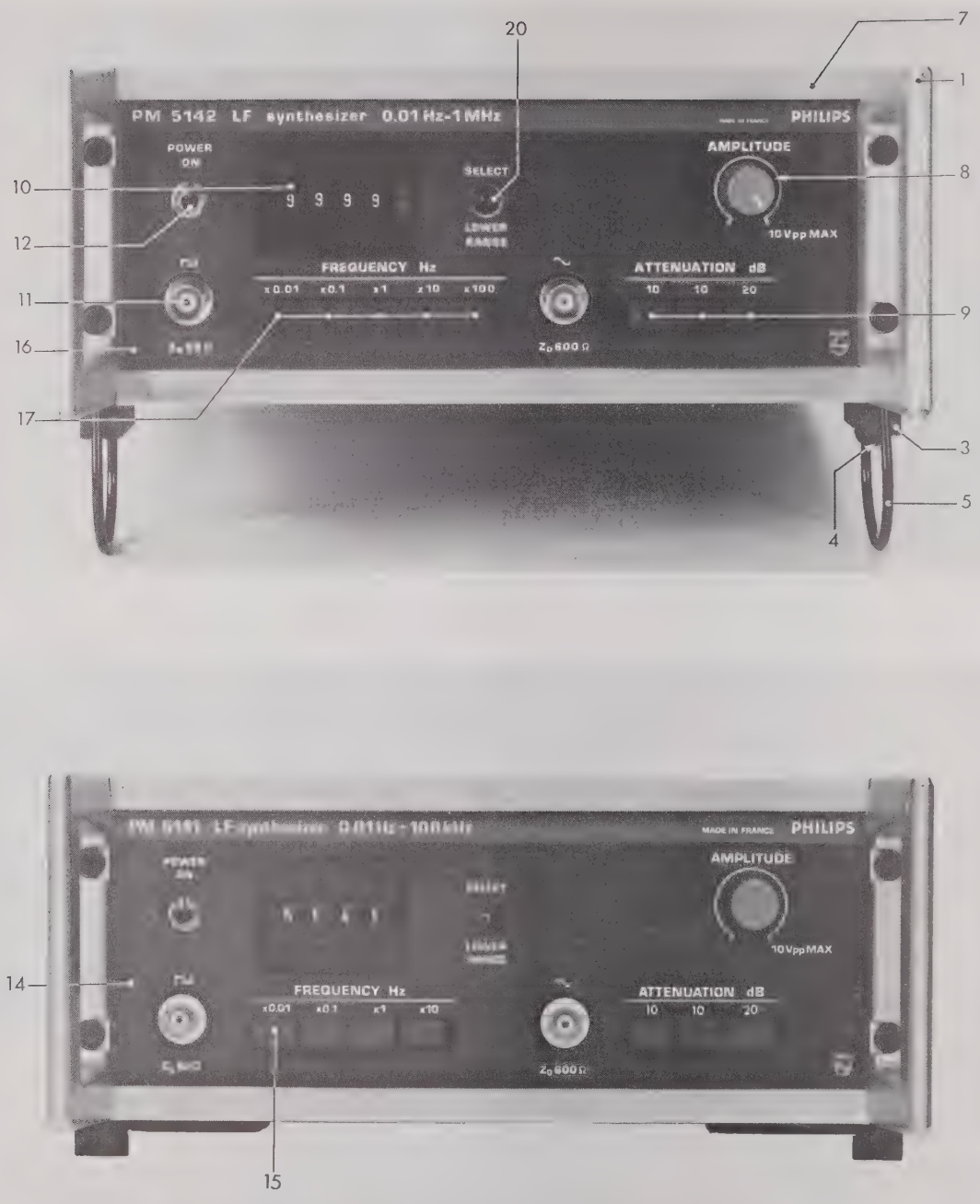


Fig. 36. Front view, mechanical parts

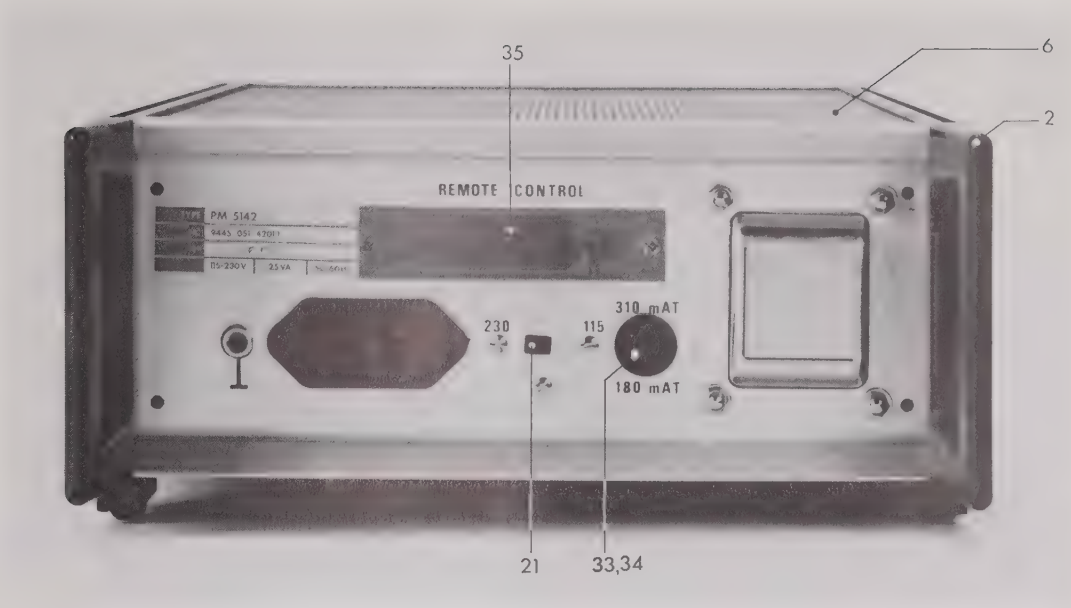


Fig. 37. Rear view, mechanical parts

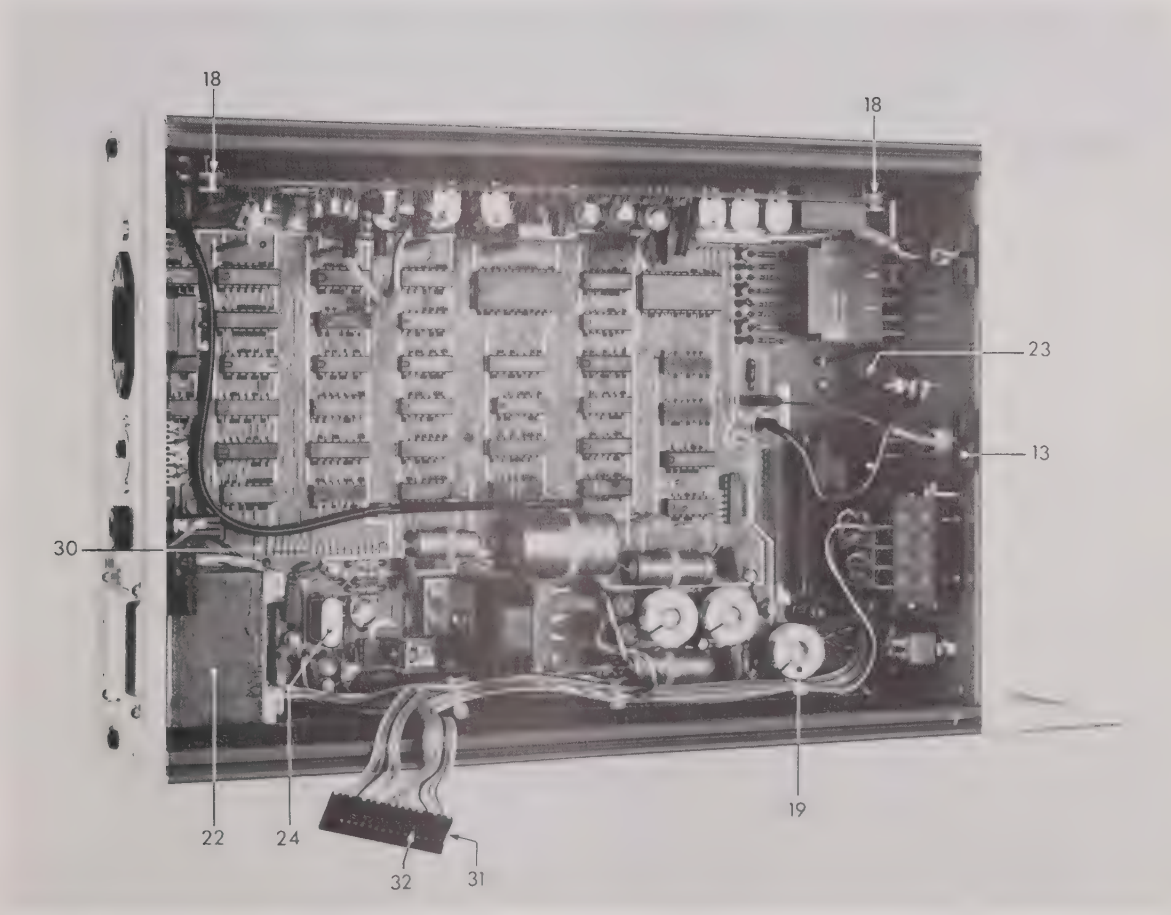


Fig. 38. Inside view, main board PM 5142

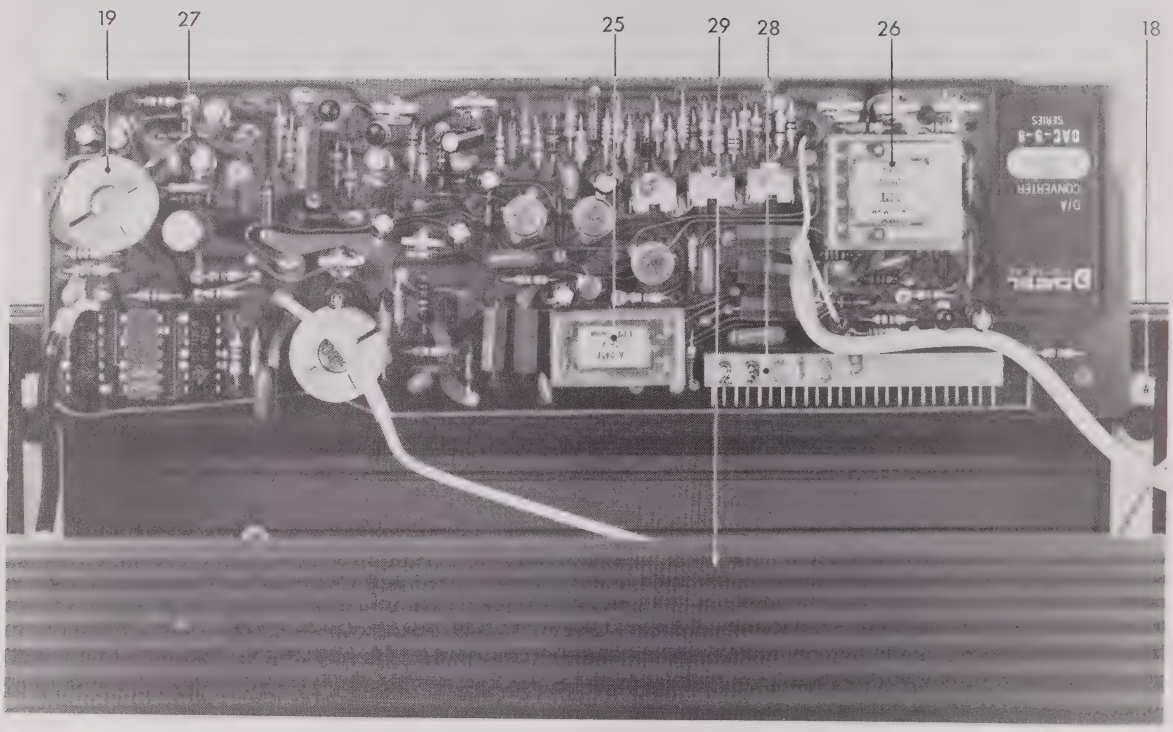


Fig. 39. Inside view, output card PM 5142

CODING SYSTEM OF FAILURE REPORTING FOR QUALITY ASSESSMENT OF T & M INSTRUMENTS

(excl. potentiometric recorders)

The information contents of the coded failure description is necessary for our computerized processing of quality data.

Since the reporting of repair and maintenance routines must be complete and exact, we give you an example of a correctly filled-out PHILIPS SERVICE Job sheet.

① Country	② Day Month Year	③ Typenumber /Version	④ Factory/Serial no.
32	150475	OPM3260/02	DO00783

CODED FAILURE DESCRIPTION ⑥

⑤ Nature of call	Location	Component/sequence no.	Category
☐ Installation		TS0607	5
☐ Pre sale repair		R00631	2
☐ Preventive maintenance	0021	990001	4
☒ Corrective maintenance			
☐ Other			

⑦ *Job completed* ☒

Working time ⑧ 12 Hrs

Detailed description of the information to be entered in the various boxes:

①Country: 32 = Switzerland

②Day Month Year 150475 = 15 April 1975

③Type number/Version OPM3260/02 = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in front of the serial no)

④Factory/Serial number DO00783 = DO 783 These data are mentioned on the type plate of the instrument

⑤ Nature of call: Enter a cross in the relevant box

⑥ Coded failure description

Location

☐☐☐☐

These four boxes are used to isolate the problem area. Write the code of the part in which the fault occurs, e.g. unit no or mechanical item no of this part (refer to 'PARTS LISTS' in the manual).

Example: 0001 for Unit 1
000A for Unit A
0075 for item 75

If units are not numbered, do not fill in the four boxes; see Example Job sheet.

Component/sequence no.

☐☐☐☐☐☐

These six boxes are intended to pinpoint the faulty component.

A. Enter the component designation as used in the circuit diagram. If the designation is alfa-numeric,the letters must be written (starting from the left) in the two left-hand boxes and the figures must be written (in such a way that the last digit occupies the right-most box) in the four right-hand boxes.

B. Parts not identified in the circuit diagram:

990000 Unknown/Not applicable
990001 Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002 Knob (incl. dial knob, cap, etc.)
990003 Probe (only if attached to instrument)
990004 Leads and associated plugs
990005 Holder (valve,transistor, fuse, board, etc.)
990006 Complete unit (p.w. board, h.t. unit, etc.)
990007 Accessory (only those without type number)
990008 Documentation (manual, supplement, etc.)
990009 Foreign object
990099 Miscellaneous

Category

☐

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement (of transistor, resistor, etc.)
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

⑦ Job completed: Enter a cross when the job has been completed.

⑧ Working time: Enter the total number of working hours spent in connection with the job (excluding travelling, waiting time, etc.), using the last box for tenths of hours.

12 = 1,2 working hours (1 h 12 min.)

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